THE JOURNAL OF GAS LIGHTING
WATER SUPPLY & SANITARY IMPROVEMENT

VOL. LVIII. No. 1481.] LONDON, SEPTEMBER 29, 1891. [43RD YEAR. Price 6d.

WOLSTON'S Paste and Ready Mixed for Use.
Guaranteed Free from Adulteration. **TORBAY PAINTS.**
FOR GASHOLDERS, &c., &c.
The Original "Torbay Paints"
As supplied during the present and many preceding years to the LONDON GASLIGHT & COKE COMPANY.
Special Quotations to Gas Companies.
TORBAY & DART PAINT Co., Ld.,
DARTMOUTH, DEVON,
And 23, Gt. George St., Westminster, S.W.

— ESTABLISHED 1830. —
PARKER & LESTER,
Manufacturers & Contractors.
THE ONLY MAKERS OF
PATENT ANTIMONY PAINT,
Parker's Imperial Black Varnish,
Oxide Paints, Oils, and General Stores for Gas and Water Works.
WORKS:
ORMSIDE STREET, OLD KENT ROAD, LONDON.
Ashmore, Benson, Pease, & Co., Ld.,
STOCKTON-ON-TEES,
Manufacturing Gas Engineers.
See Advertisement, p. 561.

CEMENT
EARLE'S
BEST
Portland Cement
MANUFACTURED BY
GEO. & THOS. EARLE,
HULL.
Offices: 7, 8, & 9, PIER STREET.
Works: WILMINGTON.
STOREAGE CAPACITY 10,000 Tons.
ESTABLISHED 1811—OVER THREE QUARTERS OF A CENTURY.
Telegraphic Address: "CEMENT HULL."

NORTON'S PATENT
"ABYSSINIAN" & ARTESIAN TUBE WELLS,
FOR TOWN WATER-WORKS AND OTHER SUPPLIES.
The following Town Water-Works Supplies have been obtained by this System, viz. :—Abbott's Langley, Aldershot, Alnwick, Cirencester, Hertford, Lechlade, St. Albans, Shrewsbury, Skegness, Southampton, Stony Stratford, Swansea, Wallingford, Watford, West Worthing, Wimborne, &c.
LE GRAND & SUTCLIFF,
HYDRAULIC ENGINEERS, 100, BUNHILL ROW, LONDON, E.C.

SELF-CONTAINED DUST-FUEL FURNACE.
MELDRUM'S PATENT.

Extract from the *Smethwick Telephone,* June 13, 1891.

GAS COMMITTEE.

"The Manager [B. W. Smith, Esq.] reported that the adoption of MELDRUM'S PATENT FURNACES, he estimated, had resulted in a saving of 150 tons of Slack during the nine months they had been at work in the Boiler-House, and 360 tons of Slack during four months in the Retort-House; the fuel used in place of slack being the fine coke dust which formerly had to be carted or boated away at considerable expense."

MELDRUM BROS., Engineers,
ATLANTIC WORKS, 13, CITY ROAD, MANCHESTER.

DANIEL HOWARD,

(Successor to the late BENJ. WHITEHOUSE),

GASHOLDER & BOILER WORKS,

WEST BROMWICH, NEAR BIRMINGHAM

(ESTABLISHED 1765).

MANUFACTURER OF TELESCOPIC AND SINGLE GASHOLDERS,

WROUGHT AND CAST IRON TANKS FOR DITTO,

PURIFIERS, CONDENSERS, SCRUBBERS, HYDRAULIC MAINS, and all kinds of GAS APPARATUS,

Wrought-Iron Roofs, Bridges, Girders, &c.,

Steam, Hot Water, and Range Boilers, Tanks, Cisterns, Boats, and all kinds of Wrought-Iron Work.

DRAWINGS, SPECIFICATIONS, AND ESTIMATES SUPPLIED ON APPLICATION.

TELEGRAPHIC ADDRESS: "COCKEY'S FROME."

EDWARD COCKEY & SONS, Ld.,

ESTABLISHED OVER HALF A CENTURY.

Gas Engineers and Contractors for the Erection of Gas-Works.

MANUFACTURERS OF IMPROVED GAS-EXHAUSTING APPARATUS.

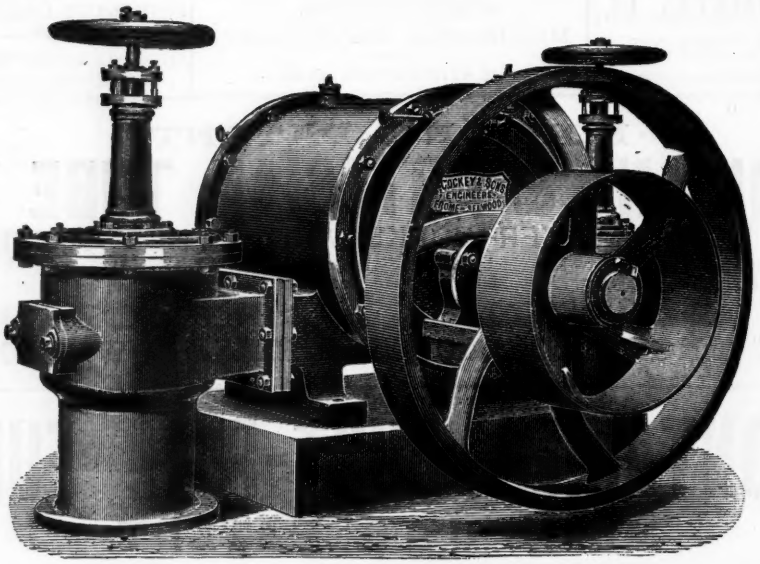
A Large Stock of Valves always on hand.

Lamp Columns; various patterns.

Wood Grids for Purifiers and Scrubbers.

Castings of every description.

Apparatus for the manufacture of Sulphate of Ammonia.



Experienced Retort-Setters constantly employed.

Lead Burning and Plumbing in all its Branches.

Gas-Fittings in great variety.

Brass Castings.

Patent Washers and Valves.

Boilers and Engines.

THE IRON-WORKS, FROME SELWOOD, SOMERSET.

HIGHEST AWARDS—LONDON, PARIS, COLOGNE, VIENNA, MELBOURNE, AND OTHERS.

—11 MEDALS.—

MANUFACTURERS OF TUBES AND FITTINGS OF EVERY DESCRIPTION.

WROUGHT-IRON OR STEEL MAINS UP TO 6 FEET DIAMETER, FOR GAS, WATER, OIL, OR OTHER PURPOSES.

SCREWING TACKLE, BOILER MOUNTINGS, VALVES, COCKS, ETC.

LONDON: 108, Southwark Street.

BIRMINGHAM: 114, Colmore Row.

LEEDS: 6, Mark Lane, New Briggate.

THOMAS PIGGOTT & CO., BIRMINGHAM.

LONDON OFFICE: ST. THOMAS APOSTLE, E.C.

GAS PLANTS, BOILERS, ENGINES, PUMPS, ROOFS, RETORT FITTINGS, ETC.

TELEGRAPHIC ADDRESS: ATLAS, BIRMINGHAM.

WELDED & RIVETED PIPES, FOUL MAINS, RETORT-LIDS, & CAST TANKS, PURIFIERS.

OVER 500 GASHOLDERS HAVE BEEN SUPPLIED AND ERECTED,

INCLUDING THOSE SUPPLIED TO THE FOLLOWING GAS COMPANIES AND CORPORATIONS:

BATH.	BOLTON.	BRISTOL.	CHELTENHAM.	LEAMINGTON.	PRESTON.	SHEFFIELD.
BELFAST.	BOMBAY.	BRISBANE.	HARTLEPOOL.	LIVERPOOL.	READING.	STOCKHOLM.
BECKTON.	BRADFORD.	CARDIFF.	LEEDS.	NOTTINGHAM.	RIO GRANDE.	SYDNEY.
BIRMINGHAM.	BRIGHTON.	COVENTRY.	LEICESTER.	OLDHAM.	SOUTH METRON.	VIENNA.

GAS COAL.

BEST

REAL OLD SILKSTONE GAS COAL,

Address, THE STRAFFORD COLLIERIES COMPANY,

Near BARNSLEY, SOUTH YORKSHIRE.

NEWTON, CHAMBERS, & CO., LIMITED

THORNCLIFFE IRON-WORKS, near SHEFFIELD,

MANUFACTURERS OF

SLIDE VALVES, WITH RACK & PINION, OR Internal or External SCREWS, of all Sizes.

GASHOLDERS, AND Gasholder Tanks.

CAST-IRON RETORTS,

RETORT-BED FITTINGS,

And Retort-House Appliances

of every description.

Iron Roofs, Columns, Girders, Floor Plates and Tools, &c.

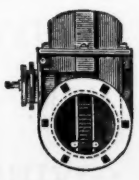
WROUGHT AND CAST IRON CONDENSERS, SCRUBBERS, & WASHERS,

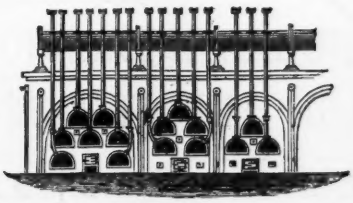
TAR AND LIQUOR PUMPS, &c.

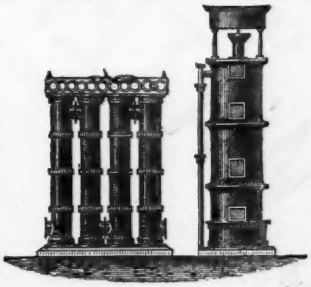
PATENT CENTRE VALVES

for working Purifiers.

Also Bye-Pass & Stop Valves.





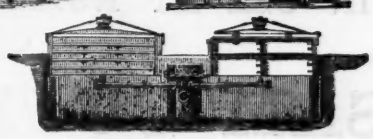


PURIFIERS with Planed Joints,

HAND and HYDRAULIC LIFTING GEAR, CAST-IRON MAINS and SPECIALS,

WOOD GRIDS.

CAST AND WROUGHT IRON TANKS AND CISTERNS.



DESIGNS, SPECIFICATIONS, AND ESTIMATES FREE.

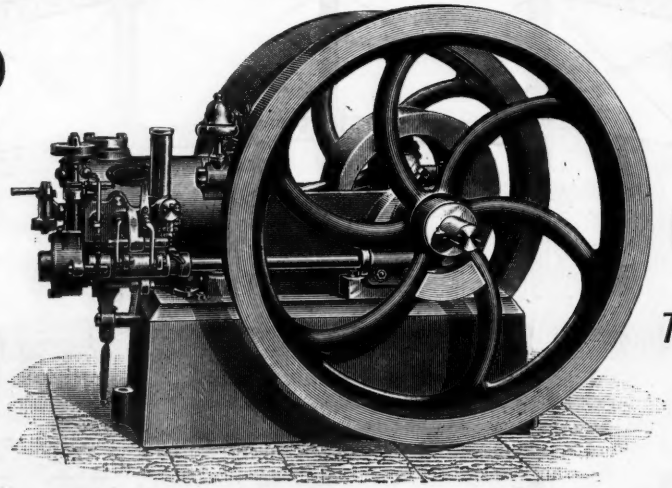
Pig Iron (*Special Quality*) for ENGINE CYLINDERS, &c.

GAS COAL FAMOUS FOR ITS UNRIVALLED EXCELLENCE.

CROSSLEY'S "OTTO" GAS-ENGINE.

SIZES, 2-MAN TO 200-HORSE POWER.

LARGELY USED FOR **EXHAUSTING, PUMPING,** Coke Crushing, &c.



CROSSLEY'S ENGINES, Combined with **PUMPS** FOR *TOWNS' SUPPLY, SEWAGE, &c., &c.*

CROSSLEY'S NEW HIGH-SPEED ENGINE FOR DIRECT ELECTRIC LIGHTING.

CROSSLEY BROS., LTD., OPENSHAW, MANCHESTER.

HARRIS & PEARSON,

STOURBRIDGE, ENGLAND.

MANUFACTURERS OF

FIRE-CLAY GAS-RETORTS, FIRE-BRICKS, LUMPS, & TILES of Every Description.

GLAZED BRICKS AND PORCELAIN BATHS.

LEAKY AND STICKING SLIDES ENTIRELY AVOIDED.

EASILY MANIPULATED.

ESPECIALLY SUITABLE FOR PURIFIERS.

CUTLER'S PATENT WATER-VALVES FOR PURIFIERS.

LEAKAGE IMPOSSIBLE.

NEAT AND COMPACT.

NO DETERIORATION THROUGH AGE AND FREQUENT USE.

IN USE AT NUMBERS OF LARGE WORKS, AND GIVING GREAT SATISFACTION.

SAML. CUTLER & SONS, Engineers,

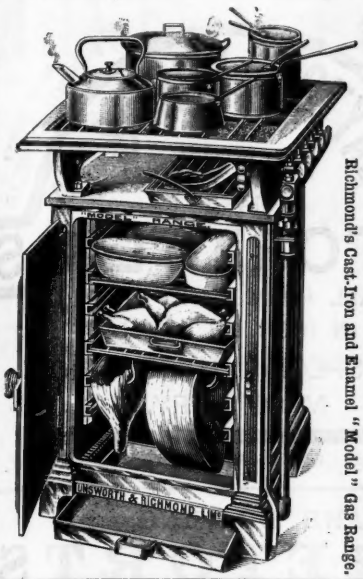
GAS AND WATER WORKS CONTRACTORS.

WORKS:
PROVIDENCE IRON-WORKS, MILLWALL, LONDON, E.
Telegrams: "CUTLER, MILLWALL, LONDON." *Telephone:* 5059.

OFFICES:
16, GT. GEORGE STREET, WESTMINSTER, S.W.
Telegrams: "RETORTUS, LONDON," *Telephone:* 8223.

A.B.C. CODE USED, 4TH EDITION, 1883.

The best Stove made for Hiring out purposes. Can be taken to pieces readily.



Richmond's Cast-Iron and Enamel "Model" Gas Range.

RICHMOND & CO., LTD.,

GAS APPARATUS MANUFACTURERS,

WARRINGTON.

This "Model" Range has been signally successful! So large a demand having been created for it, we have now for the second time in Twelve months enlarged our Works to meet the press of orders.

1.—Its chief advantages for hiring out are: All Oven Fittings, Hot Plate, Hot Plate Burners, Jet Cocks, and Gas Bar, easily removable for Cleaning.

2.—To the General Public: Clean and neat appearance, Special Simmering Burners, Blue and White Enamel, Hot Plate Burners lift out to clean. No screws. Economical and Simple.

3.—The above points are confirmed by Nelson Gas Committee's test, June 3, in which U. & R's. "Model" Range beat Wilson's, Wright's, Davis's, and three other makers for Roasting, Baking, &c., and won first place against all competitors.

Quick Lever Grill.
No. 200 10×9×7½, 7/-. No. 205 12½×11×8, 10/-.

Burners suitable for heavy work.
No. 300 12ft., 2/6. No. 302 16ft., 3/6. No. 304 20ft., 4/6.

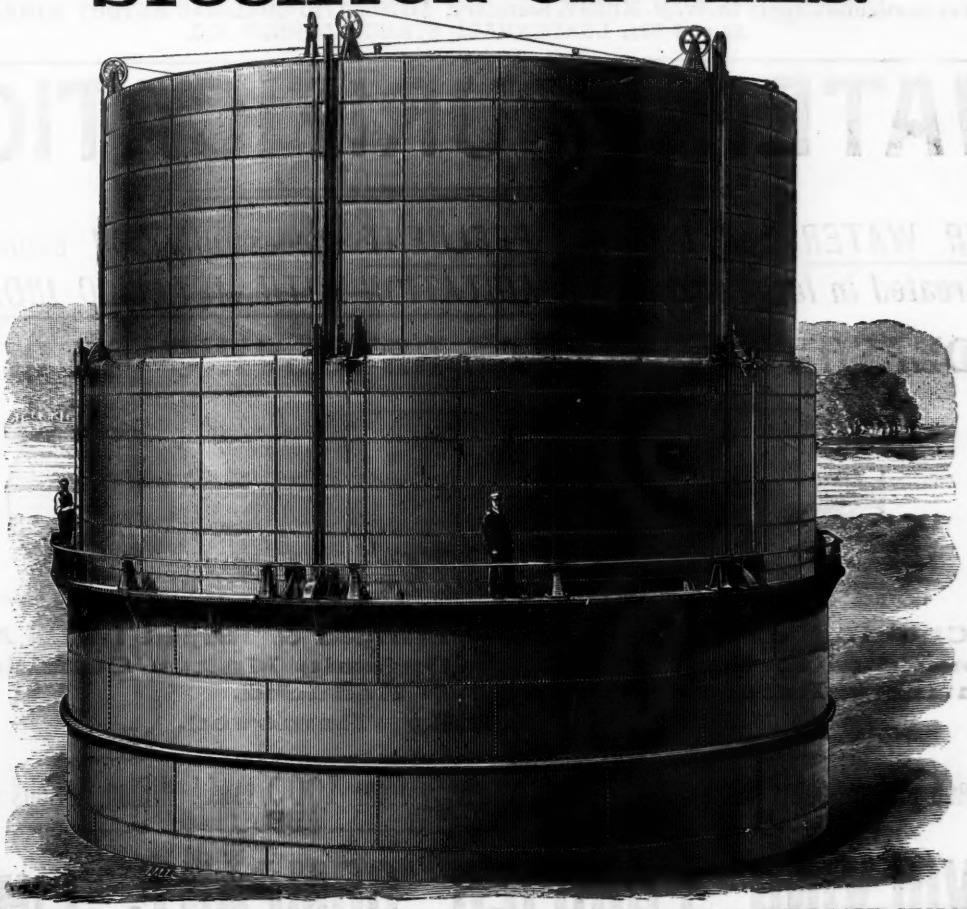
As Block. Plain Reeded Rim.
No. 306, 1/8. No. 313, 1/6. No. 315, 2/6.
No. 308, 2/6. No. 314, 2/6.

No.	Inside Dimensions of Oven.			Hot Plate.	Height over all.	Burners on Hot Plate.	For family of	Price unpacked.	Packed and Enamelled.
30	11in.	11in.	17in.	17½in. × 17½in.	28in.	2	2	£2 10 0	£3 0 0
* 40	12in.	12in.	20½in.	18½in. × 18½in.	28in.	3	4	3 0 0	3 10 0
* 50	12in.	12in.	25in.	18½in. × 18½in.	32in.	3	5	3 10 0	4 0 0
100	14in.	13½in.	28½in.	24in. × 22in.	36in.	4	6		5 15 0
120	16in.	16in.	28½in.	25½in. × 23½in.	36in.	5	10		7 0 0
140	18in.	18in.	28½in.	28in. × 26in.	36in.	6	15		9 0 0
160	22in.	21in.	32in.	31½in. × 30in.	41½in.	7	25 to 30		13 0 0

* Nos. 40 and 50, if fitted with loose Burners, Door Latch, and removable Hot Plate, 10/- extra.

ASHMORE, BENSON, PEASE, & CO., LTD.,

STOCKTON-ON-TEES.



TWO-LIFT GASHOLDER, WITH TANK, WORKING WITH PEASE'S PATENT WIRE-ROPE SUPPORTS.

(From Photograph.)

"THE METEOR."

NEW HIGH-POWER GAS-LAMP.

Westphal's Patent.

Gas Companies should hire these Lamps to their Consumers, and introduce them for Street Lighting as a rival to the Electric Light, as they do not get out of order, are most economical, and the Burner being a circular slit does not choke up.

Particulars and Prices Free.

HENRY GREENE & SONS,

SOLE CONSIGNEES FOR GREAT BRITAIN & COLONIES,
153 TO 155, CANNON STREET,
LONDON BRIDGE, E.C.

TELEGRAPHIC ADDRESS, "GAS LEEDS."

CLAYTON, SON, & Co.

LIMITED,
LEEDS,
MAKE

RETORT LIDS

OF ALL FORMS AND SHAPES
IN IRON OR STEEL
BY SPECIAL HYDRAULIC
MACHINERY.

LONDON OFFICE: 60, QUEEN VICTORIA STREET, E.C.

PRICES ON APPLICATION.

AUTOMATIC SYSTEM OF CHARGING AND DRAWING

INCLINED GAS-RETORTS.

Gold Medal, Paris Exhibition, 1889.

By this process there is obtained—

1. A SAVING OF **70** PER CENT. IN THE CARBONIZING OF COAL.
2. AN AVERAGE SAVING OF **2s. 3d.** PER TON ON ALL COAL CARBONIZED.

Which represents a saving of **One Million Sterling** per Annum to Gas Companies in the United Kingdom alone.

This System is being largely adopted at several places on the Continent and in America, and at various Gas-Works in England—notably at the Works of The Gaslight and Coke Company, the South Metropolitan Gas Company, and the Brentford Gas Company.

For Illustrated Description, see Advt. p. 418.

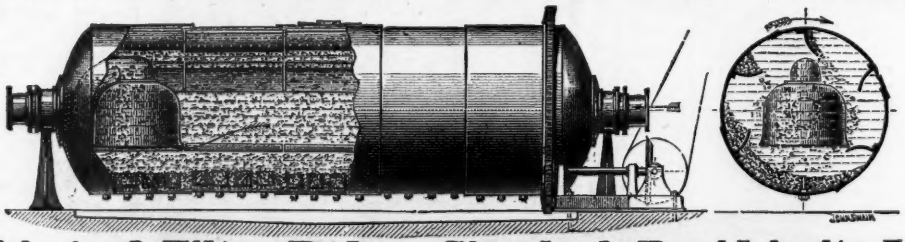
THE PROCESS IS FULLY PATENTED, AND ANY INFRINGER WILL BE STRICTLY PROCEEDED AGAINST.

For further particulars apply to W. M. KIGHT, Secretary, AUTOMATIC COAL-GAS RETORT COMPANY, LTD., 86 and 88A, LEADENHALL STREET, LONDON, E.C.

WATER PURIFICATION.

RIVER WATER and SEWAGE EFFLUENT successfully and economically treated in large volumes, by AGITATION WITH METALLIC IRON in

ANDERSON'S PATENT REVOLVING PURIFIER.



No Choking of Filter-Beds.
Colour due to Peat and Clay entirely Removed.
Simple & Rapid in its Action.
Organic Matter Considerably Reduced.
Microbes Totally Removed.

Made in Fourteen Sizes, capable of treating singly from **4000** to **1¼** Million Gallons daily.

REVOLVING PURIFIER COMPANY, LIMITED,

DOCK HOUSE, BILLITER STREET, LONDON, E.C.

JOSEPH CLIFF & SONS,

INCORPORATED IN
THE LEEDS FIRE-CLAY COMPANY, Ltd.,
WORTLEY, LEEDS.

LONDON Offices & Depôts:
Baltic Wharf, Waterloo Bridge.

WHARVES NOS. 2 & 4, INSIDE G.N. GOODS YARD, KING'S CROSS, N.

LIVERPOOL:
16, Lightbody Street.

LEEDS:
Queen Street.

MACHINE-MADE RETORTS

Have been made in large quantities for the last twelve years; and during the whole of that time, have been in regular use at most of the largest Gas-Works in the Kingdom. They possess the excellent quality of remaining as near stationary as possible under the varying conditions of their work—a quality which will be appreciated by all Gas Engineers and Managers. The generally expressed opinion is that these Retorts are the very best that are made.

RETORTS CAREFULLY PACKED FOR EXPORT.

Fire-Bricks, Lumps, Tiles, &c., &c., of every description suitable for Gas-Works.

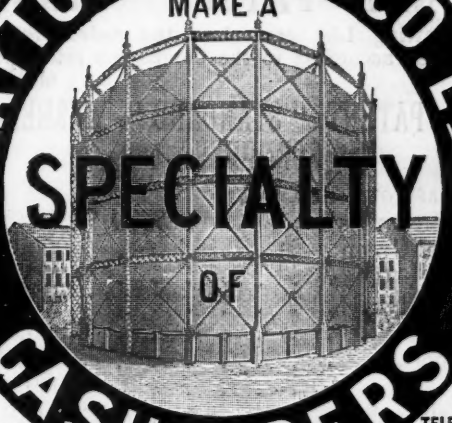
ESTABLISHED MORE THAN A QUARTER OF A CENTURY

WORKS
HUNSLET.
LEEDS

LONDON OFFICE:
60, QUEEN VICTORIA STREET
E.C.

CLAYTON SON & CO. LTD.

MAKE A



SPECIALTY OF

GASHOLDERS

AND MAKERS OF

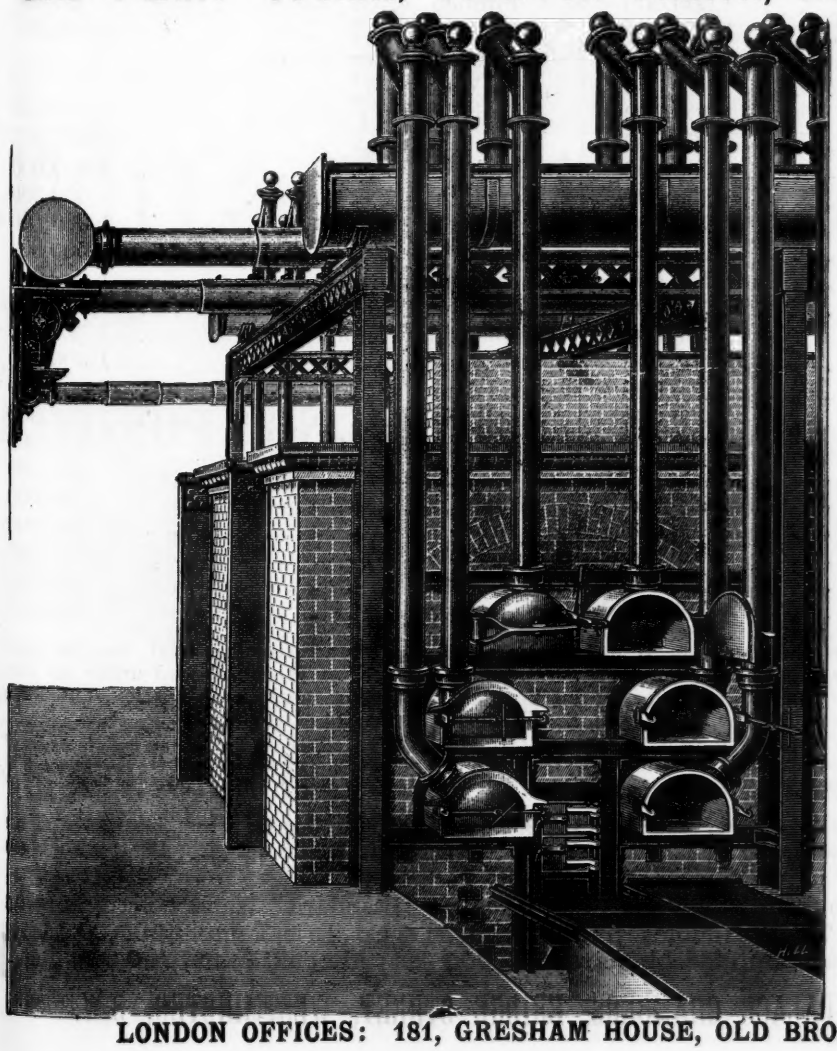
REG? TELEGRAPHIC ADDRESS: "GAS LEEDS"

GAS PLANT OF EVERY DESCRIPTION.

R. & J. DEMPSTER,

Engineers, Ironfounders, and Contractors,

GAS PLANT WORKS, NEWTON HEATH, MANCHESTER.



RETORT-BENCH

SHOWING APPLICATION OF

MESSRS. R. & J. DEMPSTER'S

PATENT

Regenerative Furnace

TO A

BED OF SIX RETORTS.

These Furnaces are very economical in the consumption of Fuel and in the wear and tear of Retorts, and require a minimum of Excavation.

Retort-Benches erected complete, with or without Regenerative Furnaces, and with Brick, Clay, or Iron Retorts.

Mouthpieces with self-sealing Lids.

Stamped Retort-Lids, in Iron or Steel.

Arms, Cross-Bars, and Screws.

Patent Wrought-Iron Ascension-Pipes.

Furnace Frames and Arch-Pipes in great variety.

Hydraulic Mains of all sections.

Hydraulic Main Regulating Valves.

Wrought-Iron Foul Mains.

Wrought or Cast Iron Brick Stays.

Steel Charging Scoops.

Sight Plugs in great variety of Designs and Sizes.

LONDON OFFICES: 181, GRESHAM HOUSE, OLD BROAD STREET, E.C.

KIRKHAM, HULETT, & CHANDLER, LIMITED.

[SIDNEY HERSEY, Managing Director.] [J. CHANDLER, Engineer.]

NEW PATENT "STANDARD" WASHER-SCRUBBERS.

The following List comprises the orders received for PATENT "STANDARD" WASHER-SCRUBBERS constructed according to the Company's latest patent, and Renewals effected by the application of same to old Pattern Machines.

NEW PATENT "STANDARD" WASHER-SCRUBBERS.

THE GASLIGHT AND COKE COMPANY—	Capacity, cub. ft. per 24 hours.
Kensal Green	3,000,000
,,	3,000,000
Birmingham	5,000,000
West Ham	3,000,000
Liverpool	3,000,000
,,	3,000,000
Rochdale	3,000,000
Manchester	2,500,000
Glasgow	2,500,000
,,	2,500,000
Leicester	2,250,000
Swansea	2,000,000
Derby	1,500,000
,,	1,000,000
Dover	1,000,000
Cambridge	1,000,000
West Bromwich	1,000,000
Warrington	1,000,000
Luton	1,000,000
Valparaiso	600,000
Barry and Cadoxton	500,000
Workington	500,000
Lowestoft	500,000
Atlas Steel Works, Sheffield	250,000
Bangor	250,000
Rawmarsh	200,000
Hitchin	150,000
Melbourne (Victoria)	1,500,000
Altoona, Penn., U.S.A.	750,000
Charlottenburg (Germany)	1,500,000
Magdeburg (Germany)	750,000
Halle (Germany)	600,000
Erfurt (Germany)	400,000
Elberfeld (Germany)	600,000
,, ,,	600,000
Bordeaux (France)	2,000,000
Nice (France)	875,000
Nancy (France)	525,000
,, ,,	525,000
St. Chamond (France)	350,000
Lille (France)	250,000
Baccarat (France)	175,000
Melun (France)	210,000
Barcelona (Spain)	875,000
Valencia (Spain)	875,000
,, ,,	200,000
,, ,,	200,000
Santander (Spain)	350,000
Vercelli (Italy)	200,000
Alger (Algiers)	875,000

RENEWALS.

THE GASLIGHT AND COKE COMPANY—	
Beckton	2,500,000
,,	1,250,000
Nine Elms (in part)	3,000,000
Shoreditch	2,500,000
Pimlico	2,000,000
Bromley	2,000,000
SOUTH METROPOLITAN GAS COMPANY—	
Vauxhall (in part)	3,000,000
Birmingham	5,000,000
Manchester	2,500,000
Plymouth	2,000,000
Croydon	1,500,000
Edinburgh	1,500,000
West Ham	1,500,000
Nottingham	1,500,000
Melbourne (Victoria)	1,500,000
,, ,,	1,500,000
Maidstone	1,000,000
Smethwick	750,000
Kingston-on-Hull	400,000
Weston-super-Mare (in part)	400,000
Enfield	300,000
Harrow	250,000
Buxton	250,000
Leominster	150,000
Kidsgrove	100,000

As a proof of the value of the invention, it may be added that, after an extended trial, The Gaslight and Coke Company have given a second order for the apparatus for their Beckton Works, a third order for two new Washer-Scrubbers, each for 3,000,000 cubic feet of Gas per day, for their Kensal Green Station, and have also adopted the system at their Nine Elms, Shoreditch, and Pimlico Stations (*Vide* List of Orders).

The patent wooden devices are being continually fitted to existing "Standard" Washers where renewals are required, and are made in segmental bundles to fit between the wheel plates, similar to the present iron sheets; and Engineers will at once see that the substitution of the improved wooden devices in place of the indented iron sheets will so very materially prolong the life of the "Standard" Washer-Scrubbers as to warrant the outlay for renewal.

The Company have recently received an order from the Birmingham Corporation for a complete set of these devices for the 5,000,000 cubic feet per day "Standard" Washer-Scrubber erected in the year 1882; also for a duplicate of this Machine (*Vide* List of Orders).

Orders recently advised by United States Agent for Patent "Standard" Washer-Scrubbers as follows: Brookline, Mass., 750,000 cubic feet; H. F. Watson & Co., Erie, Penn., 1,000,000 feet; Taunton, Mass., 300,000 feet; Springfield, Mass., 750,000 feet; Altoona, Penn., 750,000 feet.

ADDRESS: 3 & 4, PALACE CHAMBERS, BRIDGE STREET, WESTMINSTER, S.W.

R. LAIDLAW & SON,

GAS AND WATER ENGINEERS.

Manufacturers of **GAS APPARATUS** of every Description.

Makers in GLASGOW of

CAST-IRON PIPES, ALL SIZES,
LAMP PILLARS,
STEAM-ENGINES AND BOILERS,
PUMPING ENGINES FOR WATER-WORKS,
BEALE'S GAS EXHAUSTERS,
DOUBLE-FACED SLUICE VALVES,
INTERNAL AND EXTERNAL RACK OR SCREW SLIDE VALVES,
CAST-IRON COLUMNS,
BEAMS, GIRDERS, AND WATER-TANKS,
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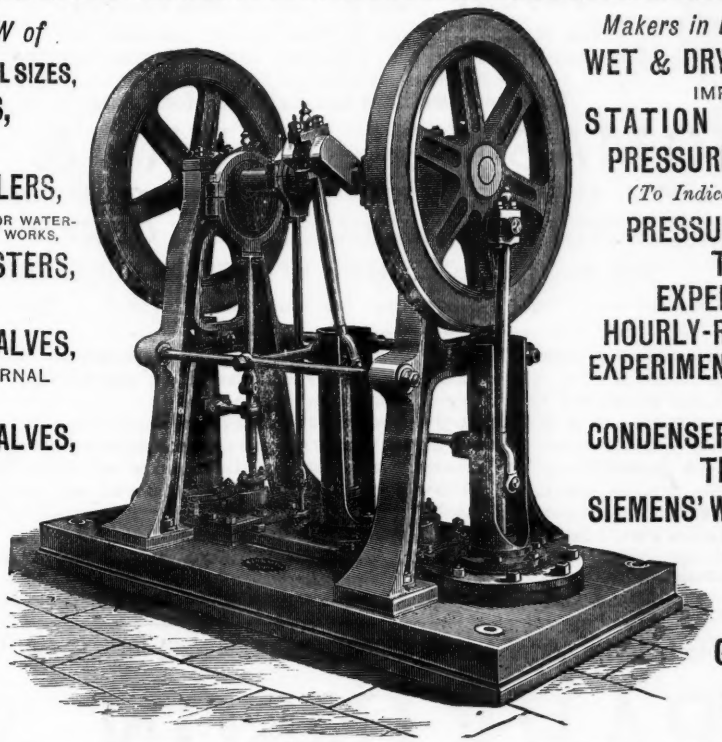

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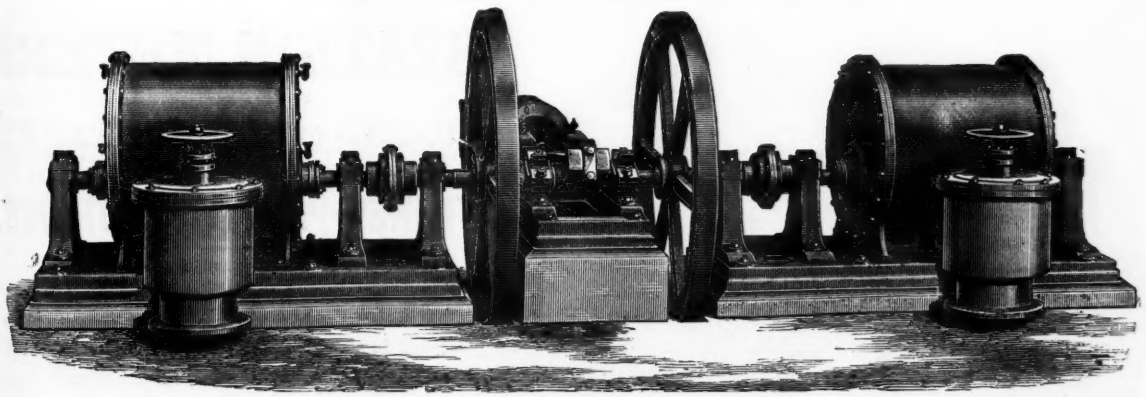

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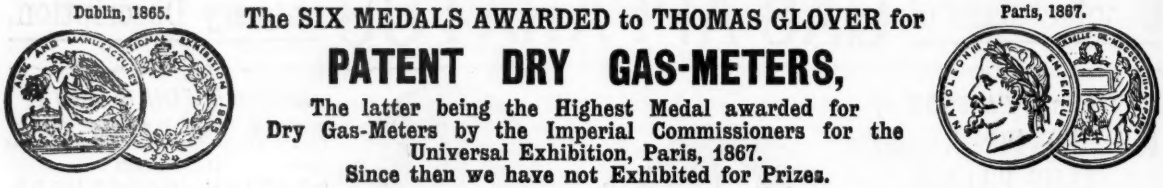

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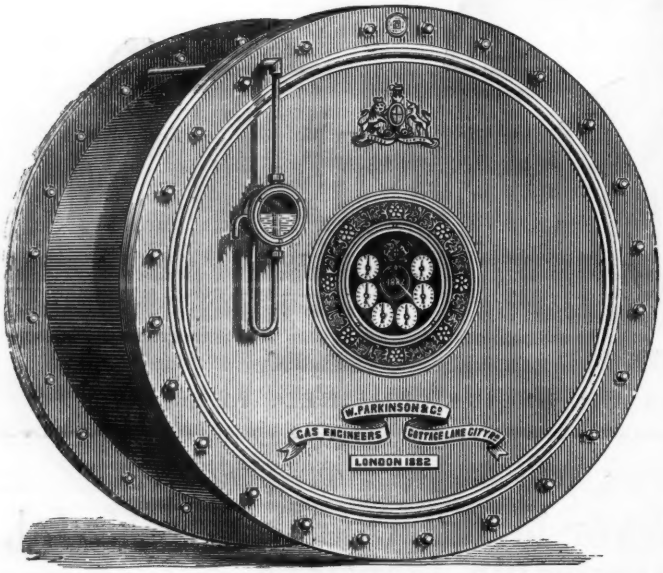

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CONTENTS.

EDITORIAL NOTES:—

GAS, LIGHTING, &c.— PAGE

Is there to Be a London Gas Question? . . . 567
Abandonment of the Autumn Meeting of the Institution of Gas Engineers . 567
The Coal Resources of England . . . 568
The Alliance and Dublin Consumers' Gas Company . . . 568
Labour Topics . . . 569

ESSAYS, COMMENTARIES, AND REVIEWS:—

Gas and Water Companies in the Stock Market . . . 570
Electric Lighting Memoranda . . . 570
Natural Gas Failing . . . 571

NOTES:—

The Hefner Standard . . . 572
A Safety Gas-Tap . . . 572
Paint for Ironwork . . . 572

COMMUNICATED ARTICLE:—

Lighting. Part I.—Theory. By W. H. Y. Webber . . . 573

TECHNICAL RECORD:—

Society of Engineers—Visit to the Shortlands and Nunhead Railway, and to the Crystal Palace District Gas-Works . . . 574
The Spontaneous Ignition of Coal. Paper by Professor Vivian B. Lewes, F.I.C., F.C.S. . . . 574
The Efficiency of Washers in the Extraction of Ammonia . . . 576
Petroleum Oil Engines . . . 577

REGISTER OF PATENTS:—

Incandescent Gas-Burners—Boult, A. J. (Chemin, J. C. O.) . . . 578
Lamp Posts or Columns—Pitt, W., Carter, H. J., and Aynsley, J. . . . 579
Charging Inclined Gas Retorts—Braidwood, J. F. . . . 579
Charging Inclined Gas Retorts—Coze, A. . . . 579
Street and other Lamps—Waddington, W. C. . . . 580
Producing Gases from Bituminous Fuel—Ross, F. E. . . . 580
Patent Notices . . . 580

CORRESPONDENCE:—

Gas Companies' Capital and Dividends . . . 581

MISCELLANEOUS:—

Alliance and Dublin Consumers' Gas Company—The Half-Yearly Report and Accounts . . . 581
Meeting of the Shrewsbury Gas Company . . . 581
Meeting of the Ottoman Gas Company, Limited . . . 582
Lincoln Corporation Gas and Water Supply—Annual Accounts . . . 582
The Introduction of Gas into New York . . . 582
Metropolis Water Supply—The Quality of the Water in August . . . 583
The Proposed Additional Water Supply for Edinburgh . . . 583
Leeds Corporation Water Supply—The Leakage at the Eccup Reservoir . 585
The Congress of Hygiene and Demography—The Papers relating to the Treatment and Disposal of Sewage . . . 585
Notes from Scotland . . . 587
Current Sales of Gas Products . . . 588
The Lancashire and Northern Coal Trades . . . 588
Gas and Water Companies' Stock and Share List . . . 589

PARAGRAPHS.—The Reward for Bravery to Mr. J. W. Helps, 569—The Copper Supplies of the World, 569—The Coal-Conveying Plant for the New Retort-House at Coventry, 569—Mr. C. E. Jones's Remarks on "Coal Storeage" at the Meeting of the Eastern Counties Association, 572—The Rating of Gas-Works, 572—A Souvenir of the North of Ireland Meeting, 578—Teignmouth Local Board Gas Supply, 580—The Jubilee of the Belfast Water Commissioners, 581—Gas Explosion at Colchester, 581—Brisbane Gas Company, 586—The Dangers of Paraffin Lamps, 586—The Norton Water-Tower of the Liverpool Water-Works, 586—Huddersfield Corporation Gas Department, 588—The Recent Damage to Imperial Ottoman Gas-Works, 588—Mr. Alexander Cameron, 589—The New Water-Works at Cardiff, 589—Issue of Additional Capital by the Maidstone Gas Company, 589—Increase in Price by the Wandsworth and Putney Gas Company, 589—Sales of Shares, 589—The Liverpool Corporation Watch Committee and the Increase in the Price of Gas, 589—Filey Water and Gas Company, 589—The Artesian Well in the City, 589—Electric Lighting at Brighton, 589—Inadequate Drainage at Newbury, 589—Windsor Gaslight Company, 589.

TO CORRESPONDENTS.

No notice can be taken of anonymous communications. Whatever is intended for insertion must be authenticated by the name and address of the writer; not necessarily for publication, but as a proof of good faith

THE

JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

TUESDAY, SEPTEMBER 29, 1891.

Is there to Be a London Gas Question?

WHEN a misrepresentation of fact, intentional or otherwise, once gets into circulation, it is notoriously difficult to overtake by correction. In regard to the facts of gas supply, which are so commonly misunderstood, misrepresentation is the rule rather than the exception in popular speech and writings dealing with the subject. We lately saw how a particularly able and fair-minded witness went wrong in the endeavour to instruct the readers of a popular monthly magazine in the mysteries of Metropolitan gas economics; and more recently we had occasion to make a very strong protest against the statements on the same topic of a self-appointed mouthpiece of those politicians of the "cock-sure" order who call themselves the Progressive Party in the London County Council. We thought at the time that more would be heard of these blundering observations; and we were not mistaken. The lead set by the *Speaker* and its oracle, Mr. Sidney Webb, has been followed by the other organ of "Progress" in London municipal affairs—the *Star*—which, in an article upon what it calls "The "London Program," hashes up Mr. Webb's matter with the addition of a little cheap sauce of its own. The article starts with a lament that while the smallest Municipality has the power to promote a Bill in Parliament for acquiring its own gas supply, the London County Council has no such power. "Here again," we are told to remark, "its hands are tied, and it has been prevented by the "Tory Government from acting in the interests of the "great city which it represents." It never seems to occur to critics of this stamp that there may be two sides to any question, or that good and sufficient reasons may exist for arrangements which, to their casual inspection, appear contrary to their desires. The London County Council has been prevented from promoting any Bill in Parliament for touching gas supply, which can be done by a provincial municipal authority, mainly because it is in no sense a similar body. It is not a municipal corporation, and it does not represent either the City of London, or the Greater London which surrounds the City, as a provincial local authority does its constituency. Such claims as those advanced by the "Progressists" of the Council render it necessary that these gentry should be advised to consider who and what they really are in the scheme of Metropolitan Government. With regard to the actual arrangements for supplying London with gas, the *Star* writer is fain to admit that something has been done to safeguard the interest of the public in the shape of statutory regulation. It is recognized that the sliding scale of selling price and dividends exists, and that under it gas consumers are permitted, to a certain extent, to share in the profits. But, it is hurriedly declared, as though the writer were afraid of the possible effect of his admission, "their share is very small, and large outlays "are made by the Companies before profits come to be "reckoned, which to a considerable extent enable them to "evade the operation of the law"—this last being, of course, understood as the chief study of gas officials everywhere with the exception of such as serve municipalities, who are to be esteemed as (literally) angels of light. The precise share of gas consumers under any statutory sliding scale of dividend and selling price varies with the circumstances of every case; but it is never less than four times the proportion taken by the shareholders, and is generally more. When gas reformers of the "Progressive" brand talk about the case of the consumers, it is to be noticed that they never commit themselves to figures. They should be made to do so before they are answered in detail. Unfortunately, experience shows that vague declamation tickles the ears of the mob; and, accordingly, those who wish to succeed as demagogues are careful not to hamper their flow of denunciation of the existing order of things, whether in connection with gas supply or otherwise, by a paralyzing regard for inconvenient facts. We do not imagine for a moment that these ravings of those who pretend to include municipalization of the gas supply of London in a suppositious "programme" of a party of the County Council will have the effect of creating a "Metropolitan Gas Question" for the ensuing County Council elections. It may appear a highly desirable thing to the most ignorant, and consequently most self-opinionated, members of this body, that they should be enabled to lay hold of the profits of the Metropolitan gas business for the purpose of spending this money upon the erection of a palace for themselves, and otherwise making good the source of indirect revenue which was lost by the cessation of the coal dues; but it is a far cry from the columns of the *Speaker* or the *Star* to a committee-room of the House of Commons; and a good deal would have to be cleared up before any scheme of municipalized gas supply for London could get thus far.

Abandonment of the Autumn Meeting of the Institution of Gas Engineers.

IT is with a feeling of disappointment which we do not care to minimize, that we learn that the Council of the Incorporated Institution of Gas Engineers have decided—reluctantly, as can well be believed—upon the abandonment of the intended Liverpool meeting, which should have taken place, according to arrangement, in about a fortnight from to-day. Upon the causes that have led the Council to take this deplorable step the professional public will not be slow to speculate. It is only too likely to create an unfavourable impression upon both the friends and the enemies of the Institution, which may be expected to deepen unless some authoritative explanation is offered of the reasons for the course that has been followed, or

unless the position of the Council can be understood upon general grounds. It is certain that, when the members of the Institution separated in May last, after a most triumphant inaugural gathering, it was with the confident anticipation of meeting again in the autumn. Liverpool was the place fixed upon for the reunion; and the choice was a most popular one. There was then every indication that the success of May would be repeated in October; and so it was believed up to within a week or two. At the last moment, however, doubts arose as to whether members would be able to attend the *rendezvous*. The holiday season has been a late one this year, owing to the bad weather of July and August; and everybody who could manage to do so protracted his vacation as far as possible into September. The consequence of this has been that many members of the Institution are only just taking up the burden of work again; and the idea of dropping it to go off to Liverpool, if only for a few days, has been not so much repugnant as impracticable. The equinox is past; winter work is beginning to take shape; extensions of plant, necessitated by the abnormal increase of last winter, must be got into train for the demand that may come at any moment after the end of next month—all these considerations combine with a late holiday to persuade the average gas engineer that he dare not leave home just now. The condition of the labour market requires attention; and although the worst tyranny of the Union is overpast, he must be a happily situated Manager who can look forward to the influx of new hands into his works at this period with the thought that this is more properly his foreman's care than his own. So it may be, to say nothing of any other consideration, that many members of the Institution of Gas Engineers cannot anyhow get to Liverpool in October. A circular has been sent round, and the nearest possible approach to a *plébiscite* has been taken on the question; with the result that the meeting is declared "off" for this time. We are sorry for it. We hold to the same opinion that has been repeatedly expressed in these columns—that there is enough of interesting matter in connection with the contemporary development of the gas industry to supply ample material for two general meetings of gas engineers and managers in the course of the year. It has been complained to us by men of science that, under existing conditions, there is a difficulty in obtaining a properly appreciative and authoritative audience before which to read good papers relating to gas topics; and what can be said now if this observation is repeated? There is only one conclusion to be drawn—the District Associations will gain by the difficulty of bringing gas managers from all parts of the country together save at one particular season of the year, and will receive some of the technical strength that should go to a National Association, but which cannot be hoarded up from May to May, or from June to June. The rest will wander off to the Society of Chemical Industry, the Institution of Civil Engineers, the Society of Arts, the Society of Engineers, and the other organizations of the kind that are always open to receive papers. It cannot be avoided, we suppose; but it is impossible to help entertaining a feeling of regret that the circumstances of the case have not turned out differently.

"The Coal Resources of England."

LAST week our correspondent who has taken the question of the coal resources of England so deeply to heart, sent a short letter commenting upon our previous remarks with regard to the export coal trade. We have no desire to enter into a controversy with anyone respecting a matter of Economics, because such disputes are generally barren, and seldom interesting. In this case, moreover, it is to be feared that our correspondent occupies a position so widely apart from our own, that we cannot hope to see eye to eye with him. We are, by conviction, Freetraders—opposed to everything which, in the shape of indirect taxation, import or export duty, or in any other way, aims at controlling for a particular end the natural course of commerce and industry. We hold that nobody should be prevented from buying anything he wants at the cheapest rate at which he can get it; and we esteem all machinery for the artificial encouragement of this or that industry, or the protection of any favoured trade, as fundamentally wrong, and incapable of producing any really good and sound fruit. Finally, we cannot believe in the rectitude of any theory which requires A. to pay a duty or extra tax on an article of consumption for the benefit of B. This, in the briefest terms, is the confession of the economic faith of the JOURNAL. Our correspondent seems to be of a different way of thinking. Without going into the general subject of Free Trade *versus* Protection, however, let us offer a few further remarks upon this particular point of the export coal trade. To begin with, it is not probable that if we were to go the length of hanging every man who should send a ton of coal out of the country, the duration of the coal supply would be increased by any appreciable term of years; just as it by no means follows that the wealth of the land in the matter of flocks and herds would be increased as the result of a general forswearing of lamb and veal. Again, our correspondent chops the terms "capital" and "current expenses," and he twits us with favouring the expenditure of the one in order to meet the other. But who can say what is capital and what is revenue in these matters? Is coal lying unmined in the earth capital, and therefore more valuable than that which, having had money spent upon winning and shipping it, is going to create more capital or to bring revenue (the surplus of which goes to capital) from the uttermost ends of the earth? These matters cannot be dealt with properly in a paragraph. One thing at least is certain—that British coal has tended to civilize the world as nothing else ever did of which the history of human progress contains any record. In British hands, it has spread the rewards of industry all over the planet, and made the ocean unite instead of dividing the peoples of the earth. It has made the deserts bear fruit for the service of man, and has led man himself to reform his savage notions as to what is good for him. Shall we permit any fantastical fears for the future of our country to tie our hands in the present, and check us in the middle of our career—the most wonderful that the brain of man ever conceived as possible for a mere handful of the human race as we are? No; a thousand times, No! Let the Future bear its own burdens, and work out its own tasks. Ours lies to our hand; and we must do it in faith that it is the right thing to do. That we should not pledge our descendants to discharge debts incurred for our convenience, we unhesitatingly maintain with regard to the affairs of local governing bodies. The National Debt, which Mr. Forster Brown wants us to insure upon our coal stock, is another thing. It represents the cost of making England free, and keeping her so; and therefore it is hard to see why our descendants, who will enjoy what this money has paid for, should not also bear their share of the burden.

The Alliance and Dublin Consumers' Gas Company.

THE shareholders of the Alliance and Dublin Consumers' Gas Company meet to-morrow to receive the report and accounts relating to the last half-year's working of the undertaking. It appears that the profit made will just clear the dividend and interest; which is a better showing than that of the previous account, and is so far satisfactory. It is even more gratifying to learn that the amount of gas accounted for in the last statement shows an increase of nearly 7 per cent. on the corresponding return for the first half of 1890. This expansion proves not only that the Company are doing well, but also that Dublin is progressing healthily along the path of prosperity. There ought to be plenty of work for the Company, and also for the Corporation, in looking after the legitimate wants of the growing population of the capital of Ireland, without squabbling over small matters, as seems to have been their pleasure hitherto. The accounts show that the sum of £14,341 has been placed to the credit of capital; this being the sum, less costs, received by the Company from the Corporation for the public lighting plant sold to the latter by arbitration. With this termination of the dual control over the public lighting plant, which arrangement was the fruitful source of infinite irritation between the parties to it, it ought to be possible to hope that more peaceful relations will prevail between the two bodies. There is every reason why there should be peace, if not cordiality, between D'Olier Street and the Dublin Council Chamber. This is a native Irish concern, existing for the benefit of consumers and capitalists who are alike, and almost equally, localized in the Irish metropolis. The Company have always treated the citizens fairly, and have tried to act forbearingly towards the Corporation. It has been difficult to do this at all

times, when any vulgar town councillor has been assured of a sympathetic hearing, by colleagues who might be suspected of knowing better, for the most baseless allegations against the collective good faith and personal honour of the Directors and chief officials of the Gas Company, well knowing the while that he could not be brought to account for his reckless words. The Directors' report is singularly devoid of all contentious references, whether to affairs within or without the undertaking. Let us hope that this is a good augury for the disappearance of all avoidable causes of unrest.

Labour Topics.

INTEREST in respect of labour news centred last week in the dockers. There was a strike on at the Carron and Hermitage Wharves in London; and there was a Dockers' Union Congress in Hull, at which Mr. Tom Mann announced his intention of retiring from the presidency of the Union, in order to contest the appointment of Secretary to the Amalgamated Engineers, to which Society he belongs. It will be news to many that, although Mr. Mann has figured before the community as representative of the Dockers, he did not belong to that somewhat inchoate body, but owed his allegiance to the much more respectable organization of the Engineers and Boiler Makers. By abandoning his newer connection, and publicly returning to his older associates, Mr. Mann has naturally led outsiders to suspect that he seeks his own interest—in other words, that the leadership of the Dockers has not been a very paying game. Perhaps it has been discovered that the newer Union has no need for the services of two such able publicists as Messrs. Mann and Tillett; and therefore these gentlemen have found it expedient to part company. We cannot sincerely say that we wish Mr. Mann success in his attempt upon the Amalgamated Engineers. That new blood is desirable in the management of this once-powerful organization may be granted; but we doubt if the new blood ought to be tainted in advance with the distinctive poison of the New Unionism—that strange farrago of Socialism, Eight-Hourism, and the other absurd economical notions with the promulgation of which the name of Tom Mann has become identified. Moreover—and there is nothing to be gained by blinking the fact—the practice of New Unionism has become unpleasantly notorious for disregarding certain obligations which no man, whether employer or employed, can set at naught and hope to retain the respect of the rest of the community, or to enjoy the power of influencing his fellows for good. New Unionism does not keep its word, does not speak the truth, does not do as it would be done by. The Amalgamated Engineers ought to be above that sort of thing. The skilled workmen who support the organization have nothing to gain by the exaggeration of their numbers and resources, by the breaking of engagements, and by countenancing Social-Democratic fallacies, all of which are incurable foibles of the self-appointed leaders of the New Unionism. Their Executive is perhaps a little touched with some of these complaints, as the conduct of the strike in the Thames ship-yards made unpleasantly plain; and they cannot afford to be exposed to increased risk of deterioration. Moreover, if the Engineers take to Mann, they will find it difficult to draw the line at Aveling, who, if not a tradesman, is a light of Unionism as it is now understood.

The fallacy underlying the idea of the legal Eight-Hour Day was once more exposed in *The Times* of last Thursday, in connection with the position of Tom Mann as an apostle of this cult. Mann recommends the restriction of all labour to eight hours a day, the abolition of overtime, and the establishment of municipal workshops, as means for curing poverty. If eight hours of working time daily will not effect the desired end, there is nothing for it, according to this luminary of the New Unionism, but to try six, or four. The remark of *The Times* upon this proposal is, Why not "go to the root of the matter "at once, and place everybody in affluence by abolishing "labour altogether?" This is a hard question, which we cannot pretend to answer, but must leave to those who profess to be able to see their way so far as to support the Eight-Hour Day. Has it ever occurred to these publicists that there is a section of the community who will not work at all, if they can help it; and that a necessary sequel of the Act restricting the labour of all adults to eight hours daily, would be another to compel everybody to work the eight hours, whether he will or not? *The Times* goes on to make some pregnant observations upon the question of work and wages, which, being supported by experience, will not strike the fancy of the New Unionist school. Our contemporary says that "the very beginning of wis-"dom for the working classes is to understand that the "best workman is their best benefactor, and that the bad "workman is their enemy. Every movement that tends "to discourage the good workman, or to level him down to "the standard of the less efficient, is directly hostile to the "interests of the working classes at large." The writer of the article remarks further on: "Under a system of free "competition, the main stress of the evil done by a bad "workman falls, as it ought to do, upon himself. Unfor-"tunately, much of it must, at the best, fall upon others. ". . . . Still, in a healthy society, in conditions of "economical freedom, the bad workman is punished in "proportion to his badness, and is subjected to the only "discipline that can improve him or deter others from "following in his ways. But, under the beautiful arrange-"ments imagined by our social quacks, the bad workman "is to be relieved of the natural punishment of his in-"competence, and the loss accruing from his economic "worthlessness is to be thrown upon the general body of "efficient and energetic producers." Words of wisdom; would that they could be trusted to carry conviction where they might do most good!

The Reward for Bravery to Mr. J. W. Helps.—At the annual general meeting of the Croydon Football Club last Tuesday, Mr. J. W. Helps was presented with the certificate and medal of the Royal Humane Society, awarded to him for saving the lives of two persons at Eastbourne in July last, as already reported in our columns. No doubt Mr. Helps received the congratulations of his brother footballers, as he has done those of his professional brethren, on this public recognition of his bravery. It must ever be a source of gratification to him that his love of athletics, in several branches of which he has shown himself to be highly proficient, has proved of such signal service to, at all events, two of his fellow-creatures.

The Copper Supplies of the World.—Statistics just compiled show that in 1887 the total copper supplies of the world were estimated at 223,078 tons. In the following year they reached 258,026 tons; and in 1889, notwithstanding the depression which followed the collapse in copper speculation, the production of the metal increased to 261,650 tons. In 1890 there was a still further jump to 269,685 tons. The most striking expansion has been witnessed in the United States, where the production rose from 25,010 tons in 1880 to 116,325 tons in 1890. During the same period the production of copper in Japan increased from 3900 to 15,000 tons; and that of Spain and Portugal, from 36,313 tons in 1880 to 52,335 tons in 1890. The Peninsula reached high-water mark in copper production in 1888, when there was an aggregate of 56,450 tons. In Chili the production has greatly diminished. In 1880 the production of copper in that country reached a total of 42,916 tons; whereas last year it amounted to only 26,120 tons. With regard to the average prices realized for fine copper, in 1880 it was £63 1s. 3d. per ton; in 1885 it had fallen to only £44 1s. 6d.; while in the following year, it dropped to the lowest point reached of recent years—viz., £40 6s. In 1888 it sprang up to £76; and in 1890 it fetched £54 1s. per ton.

The Coal-Conveying Plant for the New Retort-House at Coventry.—The contract for the engines and boilers, conveyors, elevators, and coal-storeage hoppers for the new retort-house, furnished with inclined retorts, at the Coventry Gas-Works, has been placed with Mr. Gilbert Little, of the New Conveyor Company, Limited. The system will, we understand, be arranged on lines somewhat different from any of the other plants erected by the Company. The coal in the stores will be conveyed to the receiving hopper of the elevator boots. Two elevators are placed in the stores—one at either end—to lift the coal to the top of the retort-house. At the ends and on both sides of the retort-house the storeage hoppers are to be erected (four hoppers in all) to feed the charging-waggons, which run on rails alongside the tops of the retorts. The two elevators lift the coal from the stores, and shoot it, by means of adjustable swivel spouts, either into the storeage hoppers on the near side of the retort-house, or into two patent push-plate rear roller endless steel chain conveyors, which carry the coal to the two storeage hoppers on the opposite side. The four hoppers can therefore be independently filled, so that in the event of a mishap to one of the elevators, the whole range of inclined retorts, on both sides, can be charged from one elevator. In other words, the arrangement of two elevators, two conveyors, two engines, and four hoppers, not only duplicates the machinery, but the hoppers hold about 150 tons for the night supply; leaving it necessary for the plant to run only during the day shift. Each elevator and conveyor is capable of dealing with 15 tons per hour; but the Company have designed plants with their patent steel chain conveyors and elevators to handle from 5 to 150 tons per hour.

ESSAYS, COMMENTARIES, AND REVIEWS.

GAS AND WATER COMPANIES IN THE STOCK MARKET.

(For Stock and Share List, see p. 589.)

THE chief interest in the Stock Exchange is still concentrated upon the American market; and little else is thought of, except one or two speculative markets such as Electrics and African mines. However, during the past week, the great "boom" has experienced a check, which startled some people, who appeared to think that things could keep on going up for ever. Apart from the inevitable reaction, the upward movement in prices was to some extent stopped by the advance in the value of money, which caused the Bank Directors on Thursday to raise their rate from 2½ per cent. (fixed on the 1st of July) to 3 per cent. This moderate measure was generally anticipated. The Gas Market has been slightly more active than it was in the preceding week; but it is not so firm, and the changes in quotation are for the most part, and in respect of the more important stocks, a little lower. Gaslight "A," though sticking close to 233, was put down 1; but prices remained fairly steady throughout the week. Dealings in the other issues, debenture, preference, and limited, were more extensive, and showed good average figures generally; while the "J" 10 per cent. rose 1. There was not much doing in South Metropolitans; and the quotations of "B" and "C" have been put back more nearly to a level in point of value with the "A." The debenture, however, realize a price higher than the quotation. Nothing at all was done in Commercials. Suburbans and Provincials were almost wholly neglected; but the quotations of Alliance and Dublin, both issues, have been lowered ½. The downward tendency has extended to the Continental Companies; and Imperial Continental has fallen back 2. The Indian undertakings are quiet and unchanged. Among the South American, there is an improvement of ½ in Monte Video, notwithstanding the flatness of Uruguays in the week. San Paulo is quoted at closer prices; and there are many other issues in the list that would bear treating in the same way. There has been a little more activity in the Water Companies; but the tendency is somewhat irregular. Chelsea was in good demand, and rose 1. Kent also was very firm. Some of the rest realized only moderate prices; while Southwark receded 1.

The daily operations were: Gas opened rather flat on Monday, in sympathy with the general tendency; but business was quiet. South Metropolitan "B" and "C" fell 2 each; and Alliance and Dublin, ½ each; but Gaslight "J" rose 1. Water was not changed. Business was slightly more active on Tuesday; but the inclination (except for Gaslight secured issues) was downward. Imperial Continental receded 2; and Gaslight "A," 1. Wednesday's transactions were much the same as those of the preceding day; and prices ruled on about the same lines—the only change being an advance of ½ in Monte Video. In Water, Chelsea rose 1; and Southwark fell to a similar extent. Business on Thursday was more restricted; and prices were not at their best. South Metropolitan "C" changed hands at 235, and marked a fall of 3. Friday was more animated, especially for Gaslights, the preference and debenture stocks of which were in some demand. Quotations generally remained unchanged. Water was fairly active at the old figures. Saturday was quiet, and without any special feature in either Gas or Water; and all quotations closed without variation.

ELECTRIC LIGHTING MEMORANDA.

The Frankfort Electrical Exhibition—French and United States Protection for the Electric Lamp Industry—The Cost of Arc Lighting in the United States and in England—A Question of Electrical Nomenclature.

BY all accounts, the Frankfort Electrical Exhibition, albeit International only in name, has been very fairly successful in attracting visitors from all parts, who have been repaid for their trouble by seeing a collection of the best designed and most highly finished electrical and motor machinery ever yet brought together. There is to be another Electrical Exhibition at the Crystal Palace next year; but we doubt if the interest evoked by this venture will be of a very deep or widespread order. Electrical generation and distribution are exemplified at Frankfort almost entirely by German exhibits; but it must be borne in mind that there are half-a-dozen German firms who are in the very first flight of their industry. The firm of Siemens and Halske are a host in themselves; and seeing that the electric lighting of Berlin is reputed to be the best in the world, there seems to be every reason why students of electrical engineering should make a pilgrimage to the place where German practice in this kind courts the criticism of the technicians of all countries. The most striking novelty at Frankfort is the power transmission to the grounds of the exhibition from a source at Lauffen on the River Neckar—a distance of 110 miles. The cables are worked at 15,000 volts, and transmit 110-horse power, which is expended in lighting by night and pumping water by day. The useful duty of the system is understood to be high; but nothing definite will be known upon this head until the technical jury have reported upon the plant.

The sympathy existing between France and the United States has often formed the subject of comment; but it is a curious circumstance that the agreement of the two nations upon the Protectionist policy, which may be taken as a sign of this sympathy, practically places the trade of one country in antagonism with that of the other. The United States are rabidly Protectionist, and place prohibitive duties upon manufactured articles; so is France, and does the same. Now it appears that the incandescent electric lamp is, in a very high sense of the word, an article of manufacture, inasmuch as labour in the making of it costs far more than the materials used. Consequently, these lamps are admirably suited to exhibit the application of Protection. The French authorities seem to think so, at least, and put a heavy duty upon imports of the article. It so happens that electric lamp making is a thriving American industry, and the Edison people naturally think that the French ought to have the advantage of being able to purchase their lamps, which they believe to be vastly superior to the native article. Here, however, the Tariff steps in, and exhibits to American Protectionists a remarkable illustration of the truth of the old saw which declares what is "sauce for the goose" to be also "sauce for the gander." To render M'Kinleyism complete, it certainly ought to be possible for every Protectionist country to prevent any other nation from imposing a tariff hostile to its own productions. In default of such an arrangement, we see that mutually hostile tariffs merely result in burdening consumers of protected articles with artificially high prices, and generally also with inferior goods.

It is sometimes stated, in explanation of the little headway that electric lighting, as a business, makes in the United Kingdom, that the obstacles put in the way of electricians by statutes ostensibly drawn in the public interest, not only check their operations, but also tend to heighten the cost of the light itself. It is interesting, therefore, to observe that in the United States, where circumstances are supposed to be so peculiarly favourable to the electric lighting business, the light is, as a rule, dearer than it is in England. From figures recently published in the American newspapers relative to the public lighting of the city of Buffalo, in the State of New York, which may be regarded as a fairly representative American town of the second class in point of size, it may be gathered that the arc lamps supplied by three companies, who appear to amicably share the business, are charged at 40 c. per night, which works out to £30 8s. 4d. each lamp per annum. These lamps would be served by overhead wires, so that the streets of the city are disfigured in a fashion that would not be endured for a permanency in any European town of similar standing; and yet the lighting is charged at from 15 to 20 per cent. higher than would be paid here for lamps supplied unobjectionably from underground wires. In view of these facts, it is possible to entertain the opinion that if electrical speculators had not been permitted quite so much license in America, but had been compelled to polish up their methods, and pay some respect to public interest in the matter of the appearance of the streets, the cause of electricity would have been no worse off in the long run, while the people might have had their lighting just as cheaply.

It is well known, if we may use a paradoxical form of expression, that nothing is known about the nature of electricity. In other words, electrical science is a science of phenomena, but not of origin or essentials. Electrical phenomena can be measured, classified, and utilized just as confidently as the mathematician handles his x and y; but they can only be recognized, not understood. Many consequences flow from this fact, not the least important of which is the difficulty of finding names for qualifying the phenomena, which shall be expressive, without being either question-begging or misleading. For example, since high-power electricity has come into commerce, there has been no approach, by means of the nomenclature of electrical measurement, to exactitude of expression. The units of so-called electrical pressure and quantity—the volt and the ampere—have perforce come into common use; but if an employer of these terms rashly proceeds to draw the deduction that there are such things as pressure and quantity of electricity, because they are subject to measurement, he will be sternly corrected by the first professor of physical science who overhears him talking on the subject. Time was when the apparent movement of electricity along a conductor was termed the "current;" but the use of this word was tabooed long ago by precisians, for the sufficient reason that, whatever electricity may be, it is certainly nothing that flows in a stream like water. Then people got into a way of speaking of the "tension" of electricity, and were speedily reproved for talking obvious nonsense. "Potential" is no better, being inapplicable to something which exists in action, not in mere possibility of action. Electromotive force was a term to conjure with for a few years; but we are now assured that it is "doubly wrong as well as pedantic"—which is a comfort, for it always was an awkward term to use in composition. "Pressure" seemed to correspond fairly well with the condition of electricity measured by the volt; but now *Nature* insists that the word should be dropped out of this connection, as it "has certainly led to very erroneous notions in the minds of the general public as to the functions of electric supply mains," and suggests the use of "voltage" instead. Since we do not know what it is that the volt measures, while it certainly measures something which it is necessary to take account of, there is no objection to refer its measurement to itself, and call the result "voltage." Let it be understood, therefore, that, while it is a barbarism to speak of

"footage," "gallonage," or "acreage" (although the last term has somehow slipped past the literary excisemen, whose duty it is to keep contraband words out of the English language), because the foot is a unit for measuring the known quality of length, as the gallon is for measuring that of capacity, and the acre that of land area, it is permissible to use the term voltage to signify the quality, whatever it is, of electricity, which is indicated in the terms of the volt. The term is a perfectly non-committal one; and can be discarded at any time if it should become possible to replace it with another of accepted descriptive value.

NATURAL GAS FAILING.

It was stated in the last issue of the JOURNAL, that there is some news in circulation just now about fuel gas. This is true both as regards natural and manufactured gaseous fuel. We briefly mentioned last week some reports concerning the latter description of the article, which refer to Chicago and St. Louis, and now desire to place our readers *au courant* with the position of the natural gas question, which has many interesting developments for gas engineers in general. It is necessary to exercise caution in accepting the natural gas reports which appear from time to time in the technical and newspaper press of the United States, because so many of these are put in circulation for private motives. But if the statements which have begun to appear with remarkable prominence and frequency in the pages of the *American Manufacturer* and other organs of the American manufacturing interest are to be believed, the day of the exhaustion of the world's wonder of the natural gas supply of Pennsylvania and Ohio is approaching fast. The indications of this eventuality are both direct and indirect. We published in last week's issue a "Note" on the subject of space-saving boilers, which contained the remarkable incidental observation that, when Pittsburgh factory owners accustomed to the use of gaseous fuel for their steam-boilers find themselves compelled to resume the use of solid fuel, they want more room than they can possibly spare for the necessary coal-handling and storing accommodation. This observation, taken from an authoritative source, is memorable on account of the implied assumption that the return of Pittsburgh manufacturers to the use of solid fuel is to be understood as a matter of course. This piece of evidence does not stand alone. We might refer to many other indirect indications that American engineers and manufacturers are preparing for the proximate exhaustion of the natural gas supply in many of, if not in all, the regions known as the "gas belt." For direct evidence to the same effect, it is also unnecessary to seek far afield.

Through the contemporary already mentioned, we learn that recently the Dayton (Ohio) Natural Gas Company called a meeting of consumers, and placed before them a statement of the position of the undertaking, from which we have abstracted the following particulars as bearing upon the condition of the natural gas business in this district. This report states that the capital stock of the Company is $2,500,000, with £1,000,000 of bonds. The actual amount in cash represented by these figures is $2,150,000, every dollar of which, less bankers' commission, went into the plant of the concern, still leaving a large floating debt. It is declared that the investment has never been a good one; and the Company's stock has now no market value. When the Gas Company first accepted a franchise from the city of Dayton, both parties believed that in the ceded territory a good supply of gas might be depended upon for a long period of years. It was also believed that, as one well gave out, another might be drilled near by, and would yield gas at an initial pressure equal to that of the first. When the Company began business in the spring of 1888, the rock pressure of its field was 380 lbs. per square inch. Since then the pressure has been rapidly falling off, until it is now only 238 lbs. Experience shows that, when a well pressure falls below 200 lbs., salt water begins to come in to such an extent that the well is ruined. Out of the 86 wells drilled by the Company, 19 have become worthless and are abandoned; 20 more must shortly be served in the same way; and the rest only give about one-half of their original product. Consequently, the Company are compelled to reconsider their obligations. Their present franchise requires manufacturers to be supplied with gas at a price equal to 75 per cent. of their coal bills; and from this obligation they seek to be relieved, and to be empowered to sell their remaining stock of gas at any price they can obtain for it from traders and private consumers. If the Company obtain the boon they crave, they contemplate charging 25 cents per 1000 cubic feet for supplies.

As a set-off to the above report, another was put into currency about the same time, to the effect that the wells in the St. Mary's field, Ohio, are holding out remarkably well; and that, "notwithstanding the failing of the Ohio gas fields," the price of gas in this particular district is the same to-day as it was when the fuel was first introduced. "St. Mary's to-day claims the distinction of having cheaper gas than any town in the United States. The price per month for a stove is only $1, and for a jet 5 cents." The population of this favoured place is not mentioned. On the other hand, it is definitely stated that some of the towns up the Monongahela river will be forced to return to the use of coal for the coming winter. The great Philadelphia Company have decided to advance the price of their natural gas, beginning with the month of September. The rate, when the new price goes into effect, will be 25 cents per 1000 cubic feet, less a discount of 5 cents per 1000 cubic feet for accounts paid within 15 days from date. The present net rate is 15 cents per 1000 cubic feet. With this last advance, the net price of natural gas in Pittsburgh has just doubled within a year. It is expected that the other companies supplying the gas to private consumers will follow the lead of the Philadelphia Company, and make a corresponding rise in prices. The companies supplying gas to manufacturing establishments exclusively have not yet advanced their rates; but such action may be taken. While the advance by the Philadelphia Company was hardly unexpected, it was not looked for quite so soon. It is remarked that "the probable effect of such an advance will be to make many consumers resume the use of coal, which at the present price of gas, with the generally wasteful methods of burning it, is much cheaper, though, of course, less cleanly and convenient. The cause of the advance is supposed to be the last winter's experience of the Company, when the supply was scanty and working expenses larger than in the earlier days. "With the decrease in number of consumers which it would seem will result from the increase in price, the supply for such consumers as can afford to pay the new rate will probably be more satisfactory than last winter. At last winter's figures, it was about the price of coal, the slight advantage of the latter in cost being compensated by the convenience of the former; but this last advance put the price for some on the list of luxuries."

This action of the Philadelphia Company, who practically control the natural gas business in Pittsburgh, was made the subject of a leading article in the *American Manufacturer*, the gist of which was that the advance justifies the position of those who, when it was being proclaimed years ago on all hands that the supply of natural gas was unlimited, counselled economy in its use as the best guarantee for the permanency of supply, which was so hastily assumed from mere plenitude of yield. Our contemporary observes that there is no probability of the advance in price of natural gas to the Pittsburgh householders stopping at the figure now prevailing. The actual rate may be adhered to for the winter, though even this is doubtful; but before a second winter comes upon us, it is held to be unquestionable that the price of natural gas will be higher everywhere than it is to-day. It is believed, moreover, that there are other considerations besides a scanty supply, which may be supplemented by purchases of new gas-yielding territory, that have operated to bring about the last advance in price by the Philadelphia Company. It is suggested that the Company desire to "force the adoption of economical methods and appliances in the use of gas." With reasonable care in use, and with suitable apparatus, it is held that natural gas at 20 cents per 1000 cubic feet can be depended upon to do its work as cheaply as ever, seeing that from its introduction it has been burnt "anyhow." In short, the Philadelphia Company are making a bold experiment on the faith of the popularity of their gaseous fuel. Some critics declare that, at the price now asked for gas, coal is cheaper and will be resumed in preference to it. The Company think differently, and build upon the presumption that they have still a margin to go upon before their private customers will go back to coal.

The position of the Philadelphia Company and their consumers is full of interest for gas companies supplying gaseous fuel of the ordinary kind—that is, the same gas as is used for lighting. We have here the example of a community whose acquaintance with, and consequent liking for gaseous fuel has been created by the almost gratis supply of the article. Natural gas is to all intents and purposes a mineral oil gas of little or no luminous value, but with a calorific value very little if at all inferior to that of coal or water gas of high illuminating power. It has been obtainable hitherto in such profusion that considerations of economy have rendered its use for all manufacturing and domestic purposes imperative; while no necessity for prudence in burning it to the best advantage was for a long time recognized. The systems of supply adopted by the companies that arranged for its collection and distribution took no account of the quantity delivered as a base for their charges. They merely offered to lay on gas for every purpose at a rate arrived at by the simple process of cheapening the coal bill. Did a householder or a manufacturer pay so much for coal last year? Then the gas company would be happy to supply all the gas required for a handsome discount on the amount of the coal bill. This was the popularization of gaseous fuel, with a vengeance. It is no wonder that, under such conditions, the state of the atmosphere of Pittsburgh speedily underwent a radical change; so that from being the gloomiest and dirtiest of American cities—a sort of Sheffield-cum-Widnes—it put on a clean face, and allowed its residents to do the same.

It was not long, however, before the exhaustion of one well after another taught the gas companies that such waste as that which went on in many factories, where the gas, after having been once lit, was never turned off day or night, could not be borne. The cord of discipline in the use of the gas began to be drawn rapidly tighter and tighter from the instant when the need for economy was first recognized. First the use of gas was denied to the clamp brick burners; and then the iron manufacturers and steam-power users were warned to be careful of it. The

introduction of a meter system, and the consequent charging for the supply by quantity, was a great advance in the direction of economy; and consumers began to inquire after economical stoves, which was a gain to trade. Now the time has come when natural gas must be appreciated on its merits; for it will no longer be cast forth as a refuse product of cosmical forces for man to utilize or not as he may think fit. The question is, at what price will the popular appreciation of natural gas as fuel stop? The Pennsylvania Company think that they are safe with their customers when charging 20 cents per 1000 cubic feet. And journalistic opinion agrees with them. The curious reflection arises, however, whether the same price which will retain a gaseous fuel connection after its advantages have been learnt during a period of cheaper rates, would have served to secure this business if the era of cheapness had not intervened? It is thought not in some quarters; and the experience of the artificial fuel gas and illuminating gas companies is cited in point. None of these has yet succeeded in creating a paying business in fuel gas alone—to say nothing of banishing the use of coal, as was done in Pittsburgh by natural gas—even though the commodity has been sold at the same or nearly the same prices. Upon this head, the *American Manufacturer* observes: "It is true that in some cities where illuminating gas has been supplied for fuel gas at a very moderate price to consumers, very few consumers have been found; but the inhabitants of these cities had not been taught the advantages of gas as a fuel as have persons in the cities where natural gas has been used." This remark requires some explanation. It is true that artificial fuel gas cannot be sold to advantage even at a low price; but that is because its fuel value is also low. As to the sale of illuminating gas for fuel purposes, we have yet to hear of any locality where such gas has been sold at anything like 20 cents, or 10d., per 1000 cubic feet. If it had been, it is quite possible that it would not meet with such universal adoption as natural gas has received in Pittsburgh, without some such advertisement as the latter had in the period when this fuel was practically given away.

Meanwhile, now that natural gas seems to be growing scarcer, may we express a hope that some of the capable State officials who are retained to take account of these things, will, before it is too late, take the necessary steps for the preparation of a reliable statement of the advantages—economical, industrial, social, and hygienic—that have been derived by the people inhabiting the "gas belt," from the enjoyment they have had of this marvellous gift of Nature? Has natural gas been a clear gain to the people of the United States; and if so, in what respects? Pittsburgh ought to have benefited largely from its resources in the way of cheap, clean fuel; but it would be instructive if we could learn, on indisputable authority, what the benefit really amounts to.

NOTES.

The Hefner Standard.

Herr H. Drehschmidt reported to the last meeting of the German Gas and Water Works Managers' Association, that he had investigated the subject of the ratio borne by the light of the Hefner-Alteneck amyl-acetate lamp to the light of the English standard candle, with relation to the quality of the amyl-acetate used in the standard. Different ratios for the two standards have been given by various experimentalists. In 1885 Herr Drehschmidt had occasion to determine the comparative values of the two standards, which he made out as follows: One English standard sperm candle, with a flame 45 mm. high = 1·048 Hefner light. At the same time Herr Fischer and Dr. Fieberg made a similar investigation, but arrived at a different result. Without repeating all their figures, it may be stated that they found it would be necessary to deduct 4 per cent. from photometrical valuations made with the Hefner standard to bring them to equality with the English standard candle readings. The report of the Light-Standards Commission of 1890 gave another figure; and it was considered desirable to clear up these discrepancies. Herr Cuno sent to the Imperial Technical Institute twelve candles of the kind employed in Berlin, with the request that they should be compared with the Hefner lamp. The reply was that 1 candle = 1·134 Hefner light. Herr Drehschmidt repeated his experiments with six candles cut in half, and burnt in the best way to secure a uniform result. The amyl-acetate used in the Hefner lamp was procured from Herr C. A. F. Kahlbaum, and was marked "pure." The results are published in tabular form, showing maximum and minimum determinations. The mean of all observations gave 1 candle as = 1·132 Hefner light. Another set of experiments gave the mean ratio as 1 candle = 1·129 Hefner light. In view of this difference, attention was turned to the amyl-acetate; and it was found that different samples of this commodity gave discordant results. Herr Drehschmidt concluded by recommending that some control should be established over the distribution of amyl-acetate or photometrical purposes.

A Safety Gas-Tap.

It is reported that Dr. Eugene Payne, of San Francisco, has invented a device which is intended to protect from the consequences of their own folly that section of his compatriots who at times insist on "blowing out the gas," when they retire to rest. This apparatus operates automatically through the expansion and contraction of a liquid in a small sealed reservoir. When the ordinary stopcock is opened for the purpose of lighting the gas at the burner with which it is in connection, a little chain must be pulled in order to release the safety-valve, which still keeps the gas shut off. By this operation, a small lever is made to pass over two catches, the latter of which holds it. When the gas is lighted, the liquid expands by the heat, pressing outward the first catch and releasing the lever from the second. The lever is then caught by the second catch; and will be held in the open position so long as the liquid is hot. When the gas is turned off, or otherwise extinguished, the liquid rapidly cools; and, in a few seconds, the contraction of the reservoir draws in the catch holding the lever, which is thus released, and, being subject to the action of a spring, it closes the safety-valve instantly, shutting off the gas in the event of the stopcock being left open. No more gas can pass unless the regular cock is re-opened, and the safety chain pulled. The arrangement is ingenious; but seeing that by far the greatest number of accidents with gas-fittings, of the order which it might prevent, occur in connection with the use of gas-cocks, &c., of a cheap, rubbishy order, adopted in low-class hotels and residences to save expense, it is doubtful whether any inducement short of a police ordinance would suffice to secure the general use of a gas appliance which must add to the cost of the lighting fittings.

Paint for Ironwork.

According to a writer in the *Railroad Journal*, one of the largest United States shipbuilding establishments pickles all the plates, &c., intended for best work, in a dilute solution of muriatic acid, and then passes them through rapidly revolving wire brushes, which remove all scale and dirt, leaving the surface of the iron perfectly smooth and bright. The metal is then thoroughly washed with pure water, rubbed quite dry, and immediately coated with red lead and pure raw linseed oil. The red lead is first thoroughly mixed with just enough raw linseed oil to form a very thick, tough paste, which will keep for several days without hardening. When wanted for use, this paste is thinned down to the proper consistency for painting with the same oil, and laid on at once; care being taken to leave all paint pots empty at night. A gallon of prime-coat paint thus prepared contains about 5 lbs. of oil and 18 lbs. of red lead, and will cover on first coat about 500 square feet of ironwork, and about 600 square feet in the second coat. Thus the red lead and oil get their initial "set" on the surface of the iron; and the closer the pigment is brought to the iron, the more durable it will be found. Coating the iron with oil before applying the red lead is held to be a mistake, as it prevents the paint from coming in contact with the iron, where it hardens best. The thorough clearing of the iron from scale and dirt, and drying the surface, is of the greatest importance. As to the relative expense of iron oxide paints and red lead, there is no doubt the first is cheaper in prime cost. The best railroad authorities (American) find, however, that the labour in painting structural ironwork costs twice as much as the material. The true economy must therefore be sought in the durability of the paint, as well as in the preservation of the structure from rust. Actual experiments have shown that structures painted with iron oxide needed repainting the third or fourth year, while those painted with red lead went for six years. In repainting on oxide, all the old material has to be scraped off as thoroughly as possible, at considerable expense, which is not the case with red lead, in which the old pigment remains on the metal and constitutes the best base for the new coat. When the glaring colour of red lead paint is objected to, the admixture of lamp black to the dry pigment in the proportion (say) of one ounce to the pound of lead, changes the colour of the paint to a deep chocolate. Of course, less may be used. The lamp black has the further effect of slightly retarding the setting of the paint; but if this is an objection, some japan dryers can be added to the oil used in thinning the paste.

Mr. C. E. Jones's Remarks on "Coal Storeage" at the Meeting of the Eastern Counties Association.—In our report last week of the remarks made by Mr. C. E. Jones when replying to the discussion on the subject of "Coal Storeage" introduced by him at the recent meeting of the Eastern Counties Gas Managers' Association, he was made to say that "he quite admitted that, for some eight or nine years, colliery-owners were losing 8d. or 9d. per ton." He writes to say this is incorrect, as he does not admit anything of the sort. The point he wished to make was that the colliery-owners did not earn the dividends to which they were entitled; but he did not admit that they "lost" money.

The Rating of Gas-Works.—Referring to the discussion on the subject of the rating of gas-works which took place at the recent meeting of the Eastern Counties Gas Managers' Association, reported in the JOURNAL last week, a correspondent, writing from the neighbourhood of Ruabon, remarks that the assessment of collieries in his district is made on the tonnage of coal raised; and he expresses his inability to see why this principle should not be adopted with reference to gas-works, by rating them on the quantity of gas made. The rate is 5d. per ton on the "get"—three tons of slack being taken as equivalent to a ton of coal; and the rates for a year amount, he says, to about 4s. in the pound.

COMMUNICATED ARTICLE.

LIGHTING.

By W. H. Y. Webber.

PART I.—THEORY.

The subject of illumination, as a modern writer has remarked, has hardly yet received from engineers the amount of attention which its importance deserves. The comparative study of the illuminating power of artificial lights, or photometry, has, on the other hand, been assiduously cultivated, and been carried to a high pitch of refinement, for reasons which are readily stated and easily understood. When industrious man sets about making anything, the first object of his solicitude is simply the *nature* or quality of his product; the second is its *quantity*, or number. The first thing is to demonstrate the fact that a certain process or operation is productive of a certain result—man's next care is to ascertain *how much* of the result is obtainable in return for a definite expense of trouble and cost. The history of the industry of coal gas manufacture furnishes a striking illustration of the truth of this general observation. At first, it was enough for the user of luminous gas—who in the earliest days was the producer also—that something which "showed a light" was obtainable as the result of the operation now called coal carbonization; and for some time after makers of coal gas sold it, as an article of commerce, to a distinct order of the community distinguished as consumers, a gas light was to both parties a gas light, and it was nothing more.

Naturally enough, the earliest gas-burners of which we have any record in the pages of Accum and Peckston were designed to produce flames resembling those of the oil-lamps and tallow candles which were the common means of artificial light at the period of the introduction of the new illuminant. The superiority of the new means of lighting was always demonstrated, however, by making the gas-flames three or four times more powerful than their nearest analogues. Thus, the Argand gas-burner was always much brighter than the Argand train-oil lamp, and the cockspur burner was made to resemble a whole group of candle-flames; the use of a single jet being discouraged by the gas manufacturers, for obvious reasons.

The batwing burner, however, was a very early "happy thought" of some old gas engineer; and whoever conceived the idea, did much for the popularity of gas lighting. The union-jet burner was due to the prior discovery that the lighting value of two candles was increased if their flames were allowed to touch; and it is curious that although Peckston, in explaining the reason why luminous flames were rendered more brilliant by being placed in juxtaposition to each other—that they act in mutual defence against the cooling influence of the surrounding air—hit on a most valuable principle of gas-burner design, it was left for engineers working half a century later to take further advantage of this discovery.

From the moment when the advocacy of gas lighting depended upon the demonstration that the light of gas-flames was greater than that of the candles and oil-lamps which they offered to supersede, comparative photometry became recognized as an important study for gas engineers; and the earliest writers upon the subject cannot be accused of ignorance or oversight in regard to this matter. Indeed, Accum, and Peckston following him, said all that was necessary respecting the photometrical comparison of gas-burners with the other artificial lights of their periods. All writers upon photometry from Accum to Dibdin, however, have treated the subject with strict limitation to the question of illuminating power. It was beyond their purpose to deal with lighting effect. In their hands the subject of the illuminating power of a sample of coal gas has been completely exhibited as an attribute, first, of the gas, secondly, of the burner, and, thirdly, of a number of ancillary influences.

Thus the term illuminating power, as applied to coal gas, has acquired—and necessarily acquired—a thoroughly conventional meaning. The statutory requirement that a particular gas company—say, one of the three London companies—must supply what is called 16-candle gas, is a pure convention, only to rightly understand which implies a considerable amount of technical education. A number of refinements of testing, which need not be detailed here, must be observed by the trained observer before it can be known whether or not any particular sample of gas satisfies the requirements; and when this result is obtained, it has a strictly technical meaning. The consumer, in whose interest the test is made daily, has little conception of what it signifies. In order to make him understand it, we should have to put him through a course of technical instruction the result of which would be that, while there would certainly be one unsophisticated consumer the less, there would not necessarily be one satisfied consumer the more.

For it can hardly be too pointedly reiterated that the truth to be borne in mind in connection with this subject is that the term "illuminating power," as applied to different sources of artificial light, is a purely technical and conventional term, useful only for technical purposes. Its popular repetition ought to be surrounded with the most particular precautions, if great and mischievous confusion is not to result. This is because illuminating power is a different thing altogether from illumination—one being a cause, the other an effect; and to endeavour to express an idea arising out of one subject in terms only applicable to the other, is really as confusing as it would be to state the effective power of a steam-engine in pounds of coal burnt by the boiler furnace.

It is easy to perceive why illumination has not been such an immediately pressing subject of a gas engineer's care as the illuminating power of his gas. As a manufacturer, the quality of his staple product is naturally more to him than the use that the purchaser may make of it. The terms 15, 16, or 17 candle gas accordingly mean very clear things in his mind. Mentioned in his hearing, they suggest different varieties of coal to be carbonized, and many other considerations, which it is safe to state would never occur to the non-technical hearer. It is only by contemplating the term illuminating power in this way, that we can realize how conventional is its meaning, and how far removed from the natural solicitude of the purchaser. The illuminating power of gas means something for the manufacturer to make and sell his gas by; and its legal definition is only intended to furnish a means of ascertaining, upon photometrical data, whether he fulfils the terms of his contract with the public. It has no reference to the amount of lighting effect which the consumer may obtain from the gas. If the consumer uses the standard burner in the precise way prescribed by the Act of Parliament, he will enjoy the statutory value of the gas supplied to him; but he may very easily obtain more or less, according to the manner in which he burns his gas.

What the gas consumer, in common with the user of any other means of artificial lighting, really wants is *light*. Illuminating power is only the means to this end. This truth, more frequently vaguely perceived than clearly defined, causes many misunderstandings between gas companies and consumers. To a gas manufacturer with whom judgment of gas by its nominal illuminating power has become second nature, it is nonsense to describe Paris, with its 14-candle gas, as the best lighted city in the world, while Edinburgh rejoices in 27-candle gas and New York is supplied with water gas of equal illuminating power. Yet the circumstance that such a description is possible to an untechnical observer of ordinary capacity is something to make gas engineers pause in hastily assuming that illuminating power is everything. When this piece of evidence is considered in connection with the complementary fact that complaints of bad gas are apt to be quite as rife in districts supplied with the best cannel gas of Scotland as they are in the South of England or on the Continent of Europe, it becomes an easy deduction that the convention of illuminating power must not be worked too hard in relation to gas supply.

Let us consider for a moment what is meant when we say that a particular sample of gas is of 16-candle illuminating power. The consumer is naturally led to imagine that the meaning of the term is that a certain description of gas-flame of the quality referred to ought to give him as much light as he could expect to obtain from the use of 16 standard candles; and he usually has very great difficulty in accepting the assertion. However sagely the gas manufacturer may shake his head, the consumer will generally declare his confident belief that 16 candles would give more light in his room than the standard gas-flame which he is assured is actually developing this luminous value. And he is right, from his point of view. For the standard gas-flame, which has the shape of a tulip and presents a plane surface to the observing eye equal in size to, say, that of 8 standard candles at the very extreme, cannot possibly diffuse as much light as 16 candles massed as closely together as they will satisfactorily burn. If the light of the whole 16 candles could be condensed into the space occupied by the equivalent gas-flame, the exchange of one means of lighting for the other would be a matter of indifference to the user; but the reality is widely different.

Moreover, the truth that the user requires light, and is indifferent to illuminating power, explains the abiding popularity of means of lighting which the gas maker, full of his own technical notions of the meaning of the term, is apt to despise. A single candle, or a pair, close to a man's work, especially if the direct vision of the flames is prevented by a suitable screen, suits him in certain circumstances as well as, or better than, a flaring gas pendant 4 or 5 feet away. The law of the diffusion of light explains how this may be; but the consideration seldom appeals with proper force to the gas engineer.

(To be continued.)

North of England Gas Managers' Association.—The 28th half-yearly general meeting of this Association is to be held at South Shields next Saturday, under the presidency of Mr. R. Wallis, J.P., Chairman of the South Shields Gas Company. According to the circular we have received from the Secretary (Mr. W. Hardie, of Newcastle-on-Tyne), the members and associates will assemble at the gas-works, which they will inspect, and then proceed to the offices of the Company, where, by permission of the Chairman and Directors, the business will be transacted. This will comprise an address by the President; and a paper by Mr. L. H. Armour, C.E., of Gateshead, on "A Simple Method for Preventing Stoppages in Ascension-Pipes." At the close of the meeting, the members will accept the invitation of the Directors of the Company to dinner at the Royal Hotel.

TECHNICAL RECORD.

SOCIETY OF ENGINEERS.

Visit to the Shortlands and Nunhead Railway, and to the Crystal Palace District Gas-Works.

One of the summer outings of the members of this Society took place last Thursday—the works visited being the line now in course of construction between Nunhead and Shortlands, on the London, Chatham, and Dover Railway, and the Crystal Palace District Gas Company's works. The members left Victoria and Ludgate Hill Stations (according to convenience) for Nunhead Junction just before noon—among the party being Mr. W. N. Colam, the President, Mr. G. A. Pryce Cuxson, the Secretary, Mr. W. A. Valon, of Ramsgate, President of The Incorporated Gas Institute, and Mr. J. Hepworth, Engineer of the Carlisle Gas and Water Works.

At Nunhead, the contractors for the new railway (Messrs' Lucas and Aird) had a train—composed of waggons fitted for the occasion with seats—in readiness; and by this the visitors were conveyed the whole length of the line, only alighting once to examine the work on one of the principal bridges (which is nearly complete) over the London, Brighton, and South Coast Railway at Brockley. Although the new line is not more than five miles in length, the number of bridges is considerable—averaging about five per mile—and there are to be five stations, not including those already existing at Shortlands and Nunhead. The contractors have, therefore, had some heavy and difficult work to face; but they are hoping to complete it early in the ensuing year. On arriving at Catford, the party found that Messrs. Lucas and Aird had provided luncheon for them in one of their temporary workshops; and having partaken of this, they drank to the health of the members of the firm and of the Railway Company's Engineer (Mr. J. Wolfe Barry), under whose superintendence the work is being carried out.

The company then proceeded to the Crystal Palace District Gas-Works, where they were received by the Engineer (Mr. C. Gandon, M. Inst. C. E.). Here they were divided into two parties, Mr. Gandon heading one, and his assistants (Mr. J. Watson and Mr. Gandon, jun.) the other; and these gentlemen kindly pointed out the interesting features in the old works and in those now being constructed, and gave all the information required by those of their visitors who were not *au fait* in the manufacture of gas. It may here be mentioned that the Company was registered in the year 1854; the principal idea then being to supply gas to the Crystal Palace. It was originally proposed to erect gas-works at Lower Norwood for this purpose. But works then existed at Lower Sydenham, belonging to the Sydenham Gas Company; and it was finally arranged that the Crystal Palace District Gas Company should lease these, and extend them for the supply of the Crystal Palace district. Some years afterwards the two Companies were amalgamated. The attractions of the Palace and surrounding neighbourhood caused a rapid increase in the population, and consequently in the business of the Company. Some idea of this increase may be formed by noting that the original subscribed capital of the Company was only £24,000, whereas the present paid-up capital is £381,649, and that the income for the year ending June 30 last was £148,545. With this rapid increase, the original works and site were long since found insufficient for supplying the ever-growing demands of the district; and new works were established on the present site in 1859—the works of the original Company having been now long since abandoned. The Company was incorporated by Act of Parliament in 1858. When the Society visited the works eleven years ago, the plant was equal to a daily output of 4 million cubic feet of gas; the daily consumption being then about 2½ millions. The present works consist of four retort-houses, of a united productive capacity of 5½ million cubic feet per 24 hours, and containing 960 mouth-pieces. During the twelve months ending June last, the quantity of coal carbonized was 90,114 tons. In one retort-house, West's compressed air drawing and charging machinery has been in successful use for the past three years; but at the present time this house is being overhauled, so that unfortunately the machinery was not at work on Thursday. Perhaps the most interesting piece of engineering work Mr. Gandon had to show his visitors was the new gasholder which is in course of erection. This is to consist of three lifts; the inner one being 163 ft. 6 in. in diameter, and each lift 40 ft. 6 in. high. The total capacity will be 2,500,000 cubic feet. It was seen last week that the men were busily engaged on the upper lift and the roof, which portions are now nearly finished. The present gasholders (of which there are five) have a combined storeage capacity of 3,825,000 cubic feet. On account of the continually increasing consumption of gas, it has been found necessary to considerably extend the producing plant; and, as the existing apparatus and connections were found last winter to be taxed to their utmost capacity, it has been thought advisable to commence the erection of entirely distinct works, which will, in fact, ultimately form a separate section of the works. Of this, a building has been erected to be used as an engine, boiler, and exhauster house, with an overhead water-tank and an underground tar-tank. A washer-scrubber has also been erected; and a condenser has to be put up. This will be all that is required for this year; but next year a retort-house will probably be added. At the conclusion of the inspection, the visitors were invited by Mr. Gandon to partake of light refreshments; and before they left, they drank his health, and heartily thanked him for his hospitable reception.

The Crystal Palace was next visited; and here, early in the evening, the members, with a few friends, dined together. As aptly remarked by the President, before the party separated, the day had been really well spent—it was both enjoyable and instructive, and no time was lost.

THE SPONTANEOUS IGNITION OF COAL.

By Professor VIVIAN B. LEWES, F.I.C., F.C.S.

A Paper read before the Chemical Section of the British Association at Cardiff.

The researches of Grundmann, Fleck, and Richters on the Continent have done much towards explaining the somewhat complex phenomena occurring when newly-won coal is exposed to atmospheric influences. But in this country little attention has been given to the matter; and, with the exception of a report by Sir Frederick Abel and the late Dr. Percy in 1875, which is buried in a Blue-book, as far as I know nothing has been published on the subject. The result is that the almost universally accepted explanation of the spontaneous ignition of coal is that it is due to the presence in it of iron pyrites—a theory which I think is entirely erroneous; and my excuse for bringing this paper before you is the enormous importance of the subject to one of the chief coal-producing districts in the kingdom.

The origin and formation of coal have long since been satisfactorily explained. We know that coal is a fossil fuel of purely vegetable origin; and we may look upon it as consisting of three distinct parts: (1) Carbon; (2) hydrocarbons—*i.e.*, compounds of hydrogen with carbon and also with traces of oxygen and nitrogen; and (3) mineral impurities, either derived from the sap of the original plants, which by their checked decay formed the coal measures, or else which have filtered into the coal during its formation, from the surrounding soil. Of these three factors, it is the carbon which forms the bulk of the coal, and which during combustion gives the chief portion of the heat that is evolved; while the hydrocarbons, as soon as the coal is heated, escape as gaseous products, and give the fuel the power of burning with flame. It is upon the proportions in which these principal constituents of the coal are present that the characteristic properties of the various varieties of the mineral to a great extent depend. For instance, in a good Welsh anthracite, the percentage of carbon is very high; while the amount of volatile hydrocarbons is very low. The result is that the anthracite is hard to kindle, and burns almost without flame; while a marked contrast to this is a good cannel, or even Wallsend coal, in which the percentage of carbon is considerably smaller, but in which that of the hydrocarbons is very high. Such coals easily ignite, and burn with a considerable amount of flame; or they can be utilized for the production of coal gas. The mineral substances, which are practically the impurities in the coal, and mainly form the ash left after combustion, consist of sulphate of lime (gypsum), alumina, silica, and disulphide of iron (pyrites), which latter forms the so-called coal "brasses" found in most seams to a greater or less extent.

Ever since Berzelius first expressed the opinion that the heat given out by the oxidation of iron disulphide into sulphates of iron might have an important bearing on the heating and ignition of coal, it has been adopted as the popular explanation of that phenomenon; and although the work of Dr. Richters clearly proves this not to be the case, the old explanation is still given. A notable exception, however, is in the case of our great metallurgist, Dr. Percy, who, as early as 1864, pointed out that probably oxidation of the coal had also something to do with spontaneous combustion—a prediction amply verified by Dr. Richters' researches some six years later.

This disulphide of iron is met with in coal in several different forms—sometimes as a dark powder distributed throughout the mass of coal, and scarcely to be distinguished from coal itself. In larger quantities it is often found forming thin golden-looking layers in the cleavage of the coal; while it sometimes occurs as large masses and veins; often from 1 inch to 2 inches in thickness. But inasmuch as these masses of pyrites are very heavy, they rarely find their way into the screened coal for shipment; many hundreds of tons of these "brasses" being annually picked out from the coal at the pit's mouth, and utilized in various manufacturing processes. If the air is dry, the pyrites undergo little change at ordinary temperatures; but in moist air they rapidly oxidize when in a finely-divided condition.

It is during this process of oxidation that the heat supposed to cause the ignition is evolved. But when it is considered that some of the coals most prone to spontaneous combustion contain only 0·8 per cent. of iron pyrites, and rarely more than 2 per cent., the absurdity of imagining this to be the only cause of ignition becomes manifest. If 100 lbs. of coal were taken, and the whole of the pyrites in it concentrated in one spot and

rapidly oxidized to sulphate, the temperature would barely be raised to 100° C. if all loss of heat could be avoided. Besides which, in certain manufactures, pure iron pyrites are largely used, and, when free from carbonaceous matter, may be kept in a state approaching to powder, in heaps containing many hundred tons; and although undergoing continual oxidation, I have been unable to trace a single case of heating, much less a rise of temperature which would approach the igniting-point of coal. When, however, it is mixed with finely-divided carbonaceous matter, then heating and ignition are of frequent occurrence in even moderate-sized heaps.

I have carefully determined the igniting-point of various kinds of coal, and find that—

Cannel coal ignites at	. . . . .	698·0° Fahr.	= 370° C.
Hartlepool coal	„	766·0° „	= 408° „
Lignite	„	842·0° „	= 450° „
Welsh steam coal	„	870·5° „	= 477° „

So that no stretch of the imagination could endow the small trace of pyrites scattered through a large mass of coal, and undergoing slow oxidation, with the power of reaching the needful temperature.

From these considerations, it is evident that we must unhesitatingly discard the old explanation of the cause of spontaneous ignition, and see what other factors we have to deal with.

Carbon, which constitutes so large a proportion of coal, is one of those bodies which possess to an extraordinary degree the power of attracting and condensing gases upon their surface; this power varying with the state of division and density of the particular form used. The charcoal obtained from dense forms of wood, such as box, exhibits this property to a high degree; while certain kinds of coal also possess the same characteristic, although to a less extent. The absorptive power of newly-won coal due to this surface attraction varies; but the least absorbent will take up 1¼ times its own volume of oxygen. In some coals, however, more than three times their volume of the gas is absorbed. This absorption is very rapid at first, but gradually decreases; and it is, moreover, influenced very much by temperature, for reasons which will be explained later. This absorption itself causes a rise in temperature which aids the action that is taking place. The rate of absorption varies with the amount of surface exposed, and therefore able to take part in the condensing action; so that when coal or charcoal is finally powdered, the exposed surface being much greater, absorption becomes more rapid, and a rise of temperature at once takes place. If charcoal is kept out of contact with air for a day after it has been made, and is then ground down to a powder, it will frequently fire after exposure to the air for 38 hours; while a heap of charcoal powder, of 100 bushels or more, will always ignite. It is for this reason that, in making the charcoal for gunpowder, it is always kept, after burning, for three or four days in air-tight cylinders before picking over, and from ten days to a fortnight before it is ground.

If newly-won coal be at once placed in a measured volume of oxygen, the gas is at first absorbed, and its volume diminished. But after it has been in the gas for some little time, the coal commences to give off carbon dioxide; and careful investigations show that the oxygen first taken in by the absorptive power of the carbon is now entering into chemical combination with the hydrocarbons of the coal, combining with the hydrogen to produce water, and with the carbon to form carbon dioxide, while a small proportion remains in combination in the coal itself. So that the action taking place is of two kinds—first, absorption of oxygen; and, secondly, the setting up of chemical action between the absorbed oxygen and the hydrocarbon. The absorption of oxygen gives rise to heat; and in the case of coal, this rise in temperature all tends to increase the rate of the action going on. But it is rarely sufficient to bring on spontaneous ignition, as only about one-third the amount of oxygen is absorbed by the coal that is taken up by the charcoal; and the action being much slower, tends to prevent the temperature reaching the high ignition-point of the coal. Air-dried coal absorbs oxygen more quickly than wet coal. The oxygen so absorbed is in a more active condition chemically than when present in the air, as, in the first place, it is in a condensed state; and, secondly, it is diluted with less nitrogen than in the air, as the carbon absorbs a higher proportion of oxygen than of nitrogen, and the oxygen so absorbed rapidly commences to attack the hydrocarbons present in the coal, having apparently but little effect on the carbon itself. During this action, the hydrogen of the hydrocarbons unites with the oxygen to form water, which mostly escapes as vapour; while the carbon unites with oxygen to form carbon dioxide, or carbonic acid gas. Both of these actions result in the generation of heat, which, under ordinary circumstances, is dissipated to surrounding bodies, but which, when generated in the centre of a mass of fine coal (which, owing to the fact that its interstices are filled with air, is an admirable non-conductor of heat), causes a rise of temperature that in turn increases the rate of action and generation of heat until a temperature is reached at which the so-called spontaneous ignition ensues.

The most important point to be noticed is the extraordinary effect which initial temperature has on the rapidity of chemical actions of this kind. At a low temperature, and, indeed, up to about 100° Fahr. (38° C.), the absorption of oxygen, and the consequent chemical action, will go on slowly, with practically little or no chance of undue heating taking place; but directly the temperature exceeds 100° Fahr., then, with some classes of coal, ignition is only a question of time and mass. Although the ignition-point of various coals lies above 700° Fahr., yet if many of these coals are powdered, and are placed in perforated zinc cases in masses of 2 lbs. or upwards, and are kept at a steady temperature of about 250° Fahr. in an oven, ignition will generally follow in a few hours; while between this and 150° Fahr. it will take days instead of hours for the same result to follow. At ordinary English temperatures, the mass of broken coal must be very great before much risk of ignition is incurred.

In a paper which I read before the Institution of Naval Architects,* I pointed out that in the case of coal cargoes the influence of temperature and mass could be easily traced, and that liability to spontaneous ignition increases with—

1. The increase in the bulk of the cargoes. Evidence given before the Royal Commission of 1875 showed that, in cargoes for shipment to places beyond Europe, the cases reported amount to ¼ per cent. in cargoes under 500 tons; in cargoes from 500 to 1000 tons, to 1 per cent.; 1000 to 1500 tons, to 3·5 per cent.; 1500 to 2000 tons, to 4·5 per cent.; and over 2000 tons, to no less than 9 per cent. Mass influences this action in two ways: (*a*) The larger the cargo, the more non-conducting material will there be between the spot at which heating is taking place and the cooling influence of the outer air. (*b*) The larger the cargo, the greater will be the breaking-down action of the impact of coal coming down the shoot upon the portions first loaded into the ship, and the larger thereby the fresh surface exposed to the action of the air.

2. The ports to which shipments are made; 26,631 shipments to European ports in 1873 resulting in only ten casualties, while 4485 shipments to Asia, Africa, and America gave no less than 60. This startling result is partly due to the length of time the cargo is in the vessel; the absorption and oxidation being a comparatively long action. But a far more active cause is the increase of temperature in the tropics; which converts slow action into a rapid one.

3. The kind of coal of which the cargo consists; some coals being specially liable to spontaneous heating and ignition. There is great diversity of opinion on this point, but it is pretty generally admitted that cases of heating and ignition are more frequent in coals shipped from east coast ports than in South Wales shipments. So much, however, depends upon the quantity of small coal present, that a well-loaded cargo of any coal would be safer than a cargo of Welsh steam coal in which a quantity of dust had been produced during loading.

4. The size of the coal; small coal being much more liable to spontaneous ignition than large. This is due to the increase of active absorbent surface exposed to the air—a fact which is verified by the experience of large consumers of coal on land. Gas managers recognize the fact that coal which has been stamped down or shaken down during storeage is more liable to heat than if it had been more tenderly handled; the extra breakage causing the additional risk.

5. Shipping coal rich in pyrites (or "brasses") while wet. The effect of external wetting on coal is to retard at first the absorption of oxygen, and so to check the action; but it also increases the rate of oxidation of the pyrites, and when oxidized they swell and split the coal into pieces. This increases heating, due to the exposure of fresh dry surfaces; and it is practically only in this way that the presence of pyrites tends to swell the list of spontaneous ignitions.

6. Ventilation of the cargo. For ventilation to do any good, cool air would have to sweep continuously and freely through every part of the cargo—a condition impossible to attain in coal cargoes. Anything short of that only increases the danger; ordinary methods of ventilation supplying just about the right quantity of air to create the maximum amount of heating. The reason of this is clear. A steam coal absorbs about twice its own volume of oxygen, and takes about ten days to do it, under favourable conditions; and it is this oxygen which, in the next phase of the action, enters into chemical combination, and causes serious heating. Ventilation, such as used to be sometimes arranged for by a box shaft along the keelson, with Venetian lattice up-shafts, supplies as much air as is necessary to produce the results that end in spontaneous ignition.

7. Rise in temperature in steam colliers, due to the introduction of triple expansion engines and high-pressure boilers. The increase in stokehole temperature due to this is from 5° to 10° Fahr., and this affects the temperature of the adjacent parts of the vessel.

The same factors which tend to give rise to spontaneous ignition in coal cargoes will also be found to be the chief causes of ignition in large masses of coal ashore; and the most prolific source of fire in big stores of coal at gas-works, &c., is to be found in ventilating shafts improperly applied, breaking up of the coal, or in some accidental rise in initial temperature, such as a steam-pipe or a boiler in contact with a wall against which the coal is stored. In the case of coal bunkers in modern steamers and war ships, the conditions under which the coal is placed are so totally different from those existing in a collier, that no comparison can be drawn between them. In the bunker the question of mass, which plays so important a part in a hold laden with coal, is almost entirely eliminated, as from 50 to 400 tons would be about the capacity of any ordinary bunker; and

* See JOURNAL, Vol. LV., p. 645.

it has been before shown that the cases of spontaneous ignition in masses of coal of less than 500 tons do not amount to more than ¼ per cent., and the question of initial temperature becomes the most important factor. A few years ago, such an event as a coal bunker on fire was rare; whereas at the present time hardly a week passes without some more or less serious cases occurring on the fast liners. It is evident that there must exist some well-defined cause for this enormous increase in cases of spontaneous ignition. On collecting evidence on this point, the first thing that strikes one is that bunker fires are almost entirely confined to vessels in which the bunker bulkheads are only separated from the funnel by a narrow air space, or are in close proximity to the boilers themselves; but where the bunkers are "stepped" back from the funnel casing and boilers, spontaneous ignition is a great rarity. Taking the case of a fast liner, it is found that the temperature in a coal bunker varies very considerably, according to its proximity to the air-channel round the funnel casing. Close to the outside of the bulkhead, the temperature is often as high as 200° Fahr. (93° C.); while inside, 120° Fahr. would be a fair estimate, and from the centre of the bunker to the side of the vessel it is seldom above 75° Fahr. (24° C.). The temperature, however, is higher nearer the iron decks, which, being in contact with the heated bulkhead, conduct the heat through the coal, and often raise the temperature to 100° Fahr.

It has been pointed out that if coal is kept at a high temperature, even though it may be far below its igniting-point, ignition is only a question of time; and if the bunker coal next the bulkhead is kept at 120° Fahr., any coal with a tendency to absorb oxygen will run a great chance of igniting within a few days. It is manifest that if this is the real cause of ignition, the seat of the fire ought to be discovered close to the heated bulkhead. But this is very often not the case; the mass of fire being found near the centre of the bunker, and sometimes even towards the side of the vessel. Careful examination, however, soon reveals the cause of this, as a line of charred coal is mostly to be found running from the heated bulkhead to the seat of active combustion—showing that the fire started by the high initial temperature has not had sufficient air near the bulkhead to do more than smoulder; but that as soon as it came in contact with a current of air passing up through the coal from the hatches in the decks, the smouldering mass began to burn fiercely.

The tendency to spontaneous ignition in coal has always been supposed to increase with the quantity of pyrites present in it; but experiment shows that it is the tendency or power of the coal to absorb oxygen which must be taken as the true index of danger. This may be roughly gauged by the quantity of moisture the coal has absorbed from the air, as, if much moisture is found in an air-dried sample of coal, it at once stamps it as a highly-absorbent kind, which must on that account be stored with special precautions; whereas if but little moisture is present, it is probably unable to take up enough oxygen to lead to serious mischief. This is very beautifully shown in a table compiled, I believe, by Dr. Percy; and it also makes it clear how little the pyrites have to do with ignition:—

Liability to Spontaneous Combustion.	Pyrites per Cent.	Moisture per Cent.
Very slight	1·13	2·54
	1·01 to 3·04	2·75
	1·51	3·90
Medium	1·20	4·50
	1·08	4·55
	1·15	4·75
	1·12	4·85
Great	0·83	5·30
	0·84	5·52
	1·00	9·01

When once a coal has taken up oxygen, and the early stages of heating are passed, and the temperature has again fallen, all danger of ignition is over; and it may be stored in any quantity with perfect safety. So that if it were practical to keep newly-won coal for a month in moderate-sized heaps, and then to avoid much breakage in afterwards loading it, spontaneous ignition would be almost unknown.

THE EFFICIENCY OF WASHERS IN THE EXTRACTION OF AMMONIA.

In a recent number of the *Journal für Gasbeleuchtung*, Dr. Bueb, Chemist to the German Continental Gas Company, gave the results of investigations undertaken by him early in the present year, at the request of the Berlin-Anhalt Machine Construction Company, in respect to the action of the washers at the Elberfeld Gas-Works. A translation of the article appeared a few weeks ago in the *Chemical Trade Journal*, to which we are indebted for the following particulars:—

The results of Dr. Bueb's examination are of special interest, because at Elberfeld the separation of ammonia is effected throughout half the works entirely by means of the washers; no scrubbers being placed between them and the hydraulic main. Moreover, in two-thirds of the manufacturing plant, the anti-dip arrangement is employed. The gas coming from the main is sent through the condenser, the exhauster, and a Drory's tar washer, and then passes, with a high percentage of ammonia in it, simultaneously into two washers placed side by side, each constructed for a maximum production of 18,000 cubic metres (635,500 cubic feet) per 24 hours.

The experiments were directed towards ascertaining the efficiency of the washers in extracting ammonia (1) when the total production (about 30,000 cubic metres per day) was sent through two washers simultaneously; (2) when passed through one washer only; and (3) when the maximum amount of 18,000 cubic metres was passed through one washer.

In the table below, the results given under I. (*a*) were obtained by removing the ammonia as completely as possible without regard to the strength of solution. Column I. (*b*) gives the results when, as is the case in actual working, liquors of 2·5 to 3° Baumé are produced. Under II. (*a*) and II. (*b*), the same experiments are given as under I. (*a*) and I. (*b*); but the whole production is sent through one washer. III. (*a*) and III. (*b*) give the action of the washer with the maximum quantity of gas passing through for which it was constructed. The result was tolerably satisfactory; for one washer proved sufficient to remove nearly all the ammonia from the whole production of gas—*i.e.*, nearly twice the quantity for which it was intended.

The strength of the ammoniacal liquor in the separate chambers, from the experiments given under I. (*b*)—normal arrangement—was as follows:—

	Deg. B.		Ammonia.
Chamber 1.—Water flowing off	2·8	=	23·97 grms. per litre.
„ 2 „ „	2·0	=	17·59 „ „
„ 3 „ „	1·6	=	12·49 „ „
„ 4 „ „	1·2	=	8·50 „ „
„ 5 „ „	0·8	=	5·44 „ „
„ 6 „ „	0·5	=	3·23 „ „
„ 7 „ „	0·3	=	1·17 „ „

The composition of the liquor of 2·8 Baumé was—

Total ammonia	2·397 per cent.
Volatile „	2·363 „
Fixed „	0·034 „
Carbonic acid	2·090 „
Total sulphur	1·200 „
Chlorine	0·054 „
Sulphuric acid	Trace.

The following data can be calculated from these numbers—the Series I. (*b*) being taken as the basis, as representing the ordinary course of work: From column I. (*b*), we see that 525·5 grammes of ammonia are removed from every 100 cubic metres of gas passing the washer. According to the above analysis, these 525·5 grammes are contained in 21·9 litres of ammoniacal liquor of 2·8 Baumé. We therefore find that every 100 cubic metres of gas passing the washers yield 21·9 litres of ammoniacal liquor of 2·8° Baumé, which contain—

Ammonia	525·5 grammes.
Carbonic dioxide	457·7 „
Sulphur	262·8 „

It appears from the table that the action of the washer in removing ammonia is most intimately connected with the strength of the liquor produced.

The experiments under II. (*a*) show that a single washer can almost completely purify from ammonia 30,000 cubic metres of gas per diem, when no care is taken as to the strength of liquor produced, which is actually in this case too weak to be of further use. On the other hand, when a fairly concentrated solution of 2° to 3° Baumé is produced, the action of the washer is still very good; it being capable of removing 99·2 per cent. of its ammonia from 18,000 cubic metres of gas per diem, III. (*a*), or 97·7 per cent. from 30,000 metres, II. (*b*).

The washer is therefore an apparatus of comparatively small dimensions, which is capable of performing work which could only be done previously by a whole series of scrubbers. Moreover, the management of the apparatus is very simple, and consists in regulating the water supply so as to give a liquor of the correct strength. The expenses can scarcely amount to more than those required for the pumps employed in keeping the scrubbers supplied with water.

The table contains the following particulars: (1) Quantity of gas passing through the washers per 24 hours, in cubic metres; (2) loss of pressure in the washer, in millimetres: (3) temperature of water supply, in degrees centigrade; (4) temperature of effluent water, do.; (5) temperature of gas on entering the washer, do.; (6) ammonia in the gas before entering the washer, in grammes per cubic metre; (7) ammonia in the gas after leaving the washer, do.; (8) strength of liquor produced, in degrees Baumé; (9) do., in grammes per litre; (10) ammonia obtained, percentage of total quantity present in the gas.

	I. Total Production, 30,000 Cubic Metres through both Washers simultaneously.		II. Total Production, 30,000 Cubic Metres through one Washer.		III. 18,000 Cubic Metres per 24 hours through one Washer.	
	(*a*)	(*b*)	(*a*)	(*b*)	(*a*)	(*b*)
(1)	30,000 c.m.	30,000	30,000	30,000	18,000	18,000
(2)	6 m.m.	6	20	20	4	4
(3)	8° C.	8	8	8	8	8
(4)	11° C.	12	10	11	11	12
(5)	14° C.	14	14	14	14	14
(6)	525 gr.	530	520	535·5	500	506
(7)	1·91 gr.	4·50	2·84	12·0	3·03	7·6
(8)	1·20° B.	2·80	1·20	2·8	2·70	3·8
(9)	10·10 gr.	23·97	10·14	22·8	20·40	28·1
(10)	99·60 p.c.	99·20	99·40	97·7	99·20	98·5

PETROLEUM OIL ENGINES.

At the Meeting of the British Association at Cardiff this year, Professor W. Robinson, M. E., Assoc. M. Inst. C. E., of the University College, Nottingham, read before the Mechanical Science Section a paper on the above subject, from which we make the following extracts:—

Since the successful introduction of the oil-engine by Messrs. Priestman Bros., of Hull, in 1888, many engineers have been at work, and not a few attempts have been made to use ordinary petroleum oil at once as fuel and working agent in the internal combustion engine. Approaching the problem with the knowledge gained in gas-engine work, one is led to convert the oil partially into a fixed oil gas by heat; overlooking the tarry and other products formed, which sooner or later make their presence felt by clogging the valves, passages, and working parts to such an extent that the engine soon stops short in the hands of the critical user, and forfeits the title of a thoroughly reliable working engine. It is found that when ordinary kerosene or burning oil is gradually heated, the lighter hydrocarbons are driven off first, and at higher temperatures the heavier hydrocarbons are "cracked," or split up, into various other hydrocarbons, without any deposit of carbon, so that the greater part of the oil is converted into vapour. On still further raising the temperature, the oil is partially converted into real oil gas, with tarry products which may be washed out in the process of gas making, but are troublesome in oil-engines. By regulating the temperature to a nicety below this gas-making stage, the oil may be kept in the state of vapour, especially when thoroughly mixed with air.

Experience then leads to the conclusion that a really commercial and successful oil-engine must use the oil as oil, and not as oil gas, unless the latter be cooled and cleansed. Hitherto, for large gas-engines above (say) 40-horse power, and for small ones too, without gas supply, the heavy intermediate oils have been converted into real gas, by means of a gas producer, and this oil gas when cooled takes the place of coal gas. Now, instead of the gas producer, we find in one class of oil-engine a retort, spiral coil of tubing, or other vaporizer, in which the oil is heated and converted into vapour by a lamp or oil-burner. A mixture of this vapour and air is drawn into the cylinder, and the charge is compressed before ignition; the cycle of operations in the engine cylinder being usually that of Beau de Rochas, as in the well-known "Otto" gas-engine. For example, Messrs. Crossley Bros., of Manchester, are at work upon an oil-engine in which a lamp performs a twofold function—first, to heat and evaporate the oil as it is pumped into a cast-iron retort or vaporizer; and secondly, to heat the tube igniter, which is timed by a valve similar to that in their gas-engines. This lamp has a separate supply of oil given to it by a pump, and an air-jet fed from another pump worked by the same lever as the exhaust-valve. The current of air carries up the petroleum vapour, and makes it burn. The details of this and several other attempts at workable engines of this class are still in the transition stage. Again, for the petroleum spirit engine, there are many air carburetting and heating devices to evaporate the highly-volatile hydrocarbons which make up the lighter products of petroleum, such as benzoline and gasoline. Vapour so formed readily condenses again at moderately high temperatures when subjected to pressure in the engine cylinder. However, the terrible danger and risk in storeage of these light oils prohibit their common use for this purpose.

When considering oil-engines, the fact should not be forgotten that we have an entirely different condition of things to that connected with steam or gas motors, because the engine has to prepare or gasify the oil for its own use. For instance, a steam-engine that will run for a day with good results may be expected to run in a similar manner for a long period. The boiler is relied on to supply dry steam at the desired pressure. The same may be said of the gas-engine, where we have simply to turn on the gas-cock, and rely upon the ingenuity and skill of those who manufacture the gas to make it of such quality as to give equally satisfactory results in the motor cylinder, whether used for a short or longer period. But when we come to the oil-engine, we meet with a different state of things as regards the supply of the working agent. The oil must be taken direct from its cistern, thoroughly mixed with the right proportion of air, and passed into the cylinder ready for ignition, at the rate, in some engines, of four separate charges per second; so that, unless the arrangement for dealing with these heavy oils is correct, and works with precision, the tendency to clog in the cylinder and working parts is very great. In fact, to use a homely example, the engine is like a strong-looking man with a poor constitution and suffering from pulmonary troubles; it will run well for a short time, and then, getting choked up, it will refuse to work.

In the Priestman spray maker and vaporizer, specially designed to avoid clogging of the working parts, we have a neat and practical combination of the two methods of treating the oil. A sprayed jet of oil is first broken up by compressed air playing on it in the inverted spray nozzle; then it is further mixed with air, heated, and completely vaporized by the hot products of combustion from the exhaust led round the vaporizer or mixing chamber before being allowed to escape. This is really a regenerative and heat-saving arrangement. The oil vapour thus thoroughly mixed with air in the proper proportions, is drawn through an automatic suction-valve into the engine cylinder by the piston in its forward stroke. In order to cleanse the air of dust and dirt, it is found necessary to draw it into the oil reservoir and spray maker through layers of cotton wool which are renewed from time to time. The action of the spray maker will be seen by the following experiment: First, turn off the air supply, and a flame does not light the unbroken oil-jet; next, allow the air under pressure to break up and thoroughly spray the oil, and the vapour formed is so intimately mixed with air that it rises in a cloud and can easily be ignited—burning with a bright flame. On the other hand, incomplete vaporization takes place when heavy particles of hydrocarbon are seen falling below the vapour-cloud, due to want of air pressure and consequent incomplete breaking up of the oil-jet.

By the governing arrangement adopted in the Priestman engine, the amount of hydrocarbon is diminished or increased together with the amount of air, so as to form a high explosive charge or a low one, according to the work to be done by the engine. The cover to the vaporizer or mixing chamber has a circular air passage, perforated with a large number of holes. There is the central hole through which the sprayed oil is forced into the chamber, while a cylindrical passage forms a channel for the atmospheric air to pass through before being intermixed with the sprayed oil in the vapour chamber. A wing-valve is accurately fitted in the air passage, and is put in motion by means of a spindle, which is connected by a lever to the governor balls above. The action is thus: A small portion of the air which is slightly compressed (4 to 12 lbs. above atmospheric pressure) in the oil-cistern of the engine enters the inverted nozzle, and meets the oil which has been forced by the same pressure of air through a second passage. The oil-jet is thus vaporized by the air forced upon it, and comes out in the shape of a hollow cone or cloud, to be still further mixed with a larger body of air admitted by the wing-valve in the air passage. The air for spraying and the oil through the centre tube are kept at one regular pressure, whether the engine is running light or with full load; but the amount of air through the wing passage is rightly proportioned to mix with the oil which is allowed to go through the V-shaped slot that is cut in the conical plug regulated by the governor. The auxiliary body of air, after being drawn into the mixing chamber, during the out-stroke of the piston in the working cylinder, is prevented from escaping by a small retaining valve. By this means there is a regular explosion and impulse every cycle; giving admirable regularity in running. The compressed charge in the cylinder is fired by an intermittent electric spark, made to play between the ends of two platinum wires, insulated by porcelain rods in the igniting plug, and connected to the secondary circuit of an induction coil excited by a storeage cell of about two volts, which has been known to work more than 1100 hours.

What has undoubtedly to be arrived at in the construction of oil-engines is to get economy of oil and the best mechanical results without clogging of the working parts, so that in the critical hands of the user the engine may run continuously without attention or frequent cleaning and repairs. Clogging is prevented in the Priestman engine by thoroughly mixing the oil vapour with a large proportion of clean atmospheric air, so as always to form an explosive mixture which gives complete combustion and a clean exhaust. It must be pointed out, however, that during the compression of the charge before ignition a portion of the vapour comes into contact with the walls of the cylinder, &c., and, condensing on them, never gets burned. Still this oil forms, in its heated state, a most excellent lubricant for the piston; thereby dispensing with the need of a more costly oil, and regulating the same without any attention.

I may here briefly notice my investigation of the relation between the pressure and temperature of the vapours from the different burning oils, intermediate oils, and some heavier lubricating oils, in order to throw some light on their action and behaviour in the cylinder of the common oil-engine. At the same time I have tried to find out which oils are best adapted for this use. My experiments prove that, notwithstanding the complex and varied character of the different oils examined, the law according to which the pressure of petroleum vapour varies with its temperature is represented by a perfectly regular curve for each oil. Crude petroleum, containing as it does light volatile hydrocarbons as well as the very heavy constituents, is extremely dangerous in handling, and unsuitable for use in oil-engines with ordinary storeage systems.

Another, and by far the simplest type of oil-engine is that in which the oil is injected directly as oil into compressed and heated air in a cartridge which at once acts as a vaporizer and combustion chamber. In this way heavy intermediate oils of ·850 specific gravity can be dealt with equally as well as the ordinary burning lamp oils. This type has not yet passed completely beyond the transition stage, since it has been only about a year in a workable and useful shape. Such an oil-engine is the invention of Mr. H. Akroyd Stuart, of Bletchley; and it is now being made by Messrs. Hornsby and Sons, of Grantham. A novel feature of this engine is that the ordinary gear for firing the charge by a heated tube, flame, or electric spark is dispensed with altogether, and heavy oil is ignited and

completely burned when injected into the compressed and heated air in the vaporizer or cartridge. The cartridge is quickly heated up at the start by the fierce flame of a special oil-lamp urged by an air-blast from a small fan driven by hand. The working parts are few, and the details are being improved by Messrs. Hornsby as experience indicates or dictates. The oil is contained in a cistern in the base of the casting; and the supply can easily be replenished at any time during a run, by sliding open the top cover and pouring in the oil. Every charge of oil is forced, by means of a positive-action oil-pump, through a thin copper tube and simple nozzle, into the red-hot vaporizer at the proper moment for ignition—just after the air has been compressed into the red-hot cartridge and the piston is on the return stroke. A screw stop adjusts the stroke of the pump to give the right quantity of oil. When the load is thrown off and the speed becomes too high, the governor lifts a valve, and stops the supply of oil until the speed is reduced to the normal. With a large fly-wheel and at high speed (about 210 revolutions per minute), the regularity of the running of this engine, having the "Otto" cycle, under full load and then light, was much better than I had expected. In order to secure uniform speed for electric lighting, the tendency in this direction—and, as I take it, rightly too—is to use larger fly-wheels on internal-combustion engines, and run at much higher speeds than heretofore. I tried a 6-horse power engine during a run of about three hours, using oil of ·854 specific gravity, and having a flashing-point at 220° Fahr.; and the rate of the consumption was less than a pint per brake horse power per hour. Even heavier oils might be tried; the hot water from the water-jacket going to heat up the heavy oil, to keep it in a sufficiently fluid state for use in winter. The action in the engine cylinder, although the same cycle, is very different from that in the Priestman oil-engine, inasmuch as there is an excess of air in the cylinder, and this is compressed before the oil is injected. Consequently, the combustion is rapid, and will be complete even when heavy oils of great heating power are used. Since the air is dry, and there is no condensation of oil, the cylinder requires independent lubrication, as in the case of the gas-engines.

A feeling of safety to the public naturally tends to the use of heavy oil from which the lighter constituents have been driven off or distilled. I have found the loss in weight for some heavy oils by prolonged heating at low temperatures; keeping the oils exposed to the air, and allowing free evaporation. Known weights of oil were taken in shallow dishes, about 3 inches across the top, and gently heated in a sand bath by a very small steady flame for three hours; the temperature of the oil being kept constant. The proportion of volatile constituents present in the three samples are indicated in the following table:—

Name of Sample.	Specific Gravity 60° F. (15·5° C.)	Constant Temperature, in Degrees Centigrade.	Time of Evaporation. (Hours.)	Percentage Loss.	Total Percentage Loss in Three Hours.
Broxburn light-house oil used in the Priestman engine. . . .	·811	40 to 45	1·5	1·63	6·90
		60 to 65	1·5	5·27	
Intermediate shale oil.	·846	40 to 45	1·5	1·12	3·57
		65 to 75	1·5	2·45	
Lubricating oil used in Hornsby-Akroyd engine .	·854	40 to 45	1·5	1·00	2·96
		60 to 65	1·5	1·96	
		Steam bath (95)	3·0	12·42	12·42

The terribly explosive character of hydrocarbons driven off at the ordinary temperature, renders the safe storeage of petroleum imperative. Instead of the present tank system, Mr. B. H. Thwaite has devised a safety oil-tank very much like a gasholder; the cover-plate being kept in contact with the oil, and counterbalanced by weights to give only a slight pressure of 1 or 2 inches of water on the surface of the oil. The balanced frame is connected to an annular water-seal stand-pipe, to draw off any gas that collects. There is no necessity for the introduction of air to allow the tank or holder to be emptied; and as the oil is kept cool and always under slight pressure, it is impossible for a dangerous explosive mixture to accumulate inside the tank. Any gas given off during the heat of the day is not lost, but may be collected, or partly re-condensed at the lower night temperature, since there is no air present. One realizes the danger of crude oil having light volatile constituents on a hot summer's day with sparks or lightning flashes about. In the case of heavy distilled oil, the risk is very greatly reduced; and there is practically no danger in the use of this heavy oil for motive power in engines.

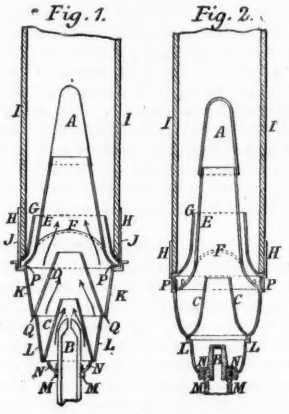
A Souvenir of the North of Ireland Meeting.—We have received a copy of the photograph of the group of members of the North of Ireland Association of Gas Managers, taken at the Belfast Gas-Works on the occasion of the recent meeting of the Association in that city. The group consists of thirty-five gentlemen, whose names are printed at the foot of the picture. It is an excellent example of the photographic art, as may be supposed when it is stated that it is the production of Mr. R. Welch, of Belfast, whose series of photographs of Irish scenery and antiquities are well known to all visitors to the Emerald Isle.

REGISTER OF PATENTS.

Incandescent Gas-Burners.—Boult, A. J.; communicated from J. C. O. Chemin, of Paris. No. 9240; June 1, 1891. [8d.]

The object of this improved burner is to enable ordinary or carburetted gas, water gas, air gas, or natural gas to be employed for heating to incandescence a mantle, cap, or dome of wire or other suitable incombustible material, and to utilize the glow or light radiating from such incandescent cap for lighting purposes; while the external shape and arrangement of the burner is the same as that of ordinary gas-burners. In reference to his invention, the patentee says: "This burner is especially applicable in towns through which gas is conveyed under a pressure approaching that which prevails in Paris; so that it cannot of itself cause a sufficient quantity of air to be carried away and mixed with it to produce an igniting mixture, capable of generating the maximum temperature which the gas might attain under favourable circumstances. Now this burner solves the problem of automatically creating a sufficient supply of air for this purpose without any special mechanism but by its own normal operation."

Fig. 1. Fig. 2.



In fig. 1 (which is a diagrammatic sectional view of the improved burner, enabling the theoretic principle of its operation to be understood), the burner is shown to consist of a vessel or chamber J K L, preferably of porcelain or metal, provided at top with a chimney holder H and its attachments. The vessel or chamber is of any convenient external shape, and is provided throughout its height with a number of orifices of any desired form. Into the lower portion of it, a jet burner B projects, having one or more openings, whereon the vessel may be fastened by a double nut, or by a flange or collar N and a nut M. The burner itself is screwed on to any support—such as a bracket, lamp, chandelier, &c. The vessel or chamber is fitted internally with offsets P Q, upon which rest truncated cones having straight or curved surfaces. The first or lowermost truncated cone C causes the first mixture to form between the gas issuing from the jet B and the air entering through the perforated or open portion L. The second cone D acts upon the initial mixture issuing from the first cone C in the same way as the first cone C acted upon the gas from the jet B; and the mixture takes up more air from the openings of the part K, so that, on leaving the second cone D, the mixture receives another supply of air from orifices of the part J provided for the purpose. This successive admission of air is assisted and increased by the draught created by the glass chimney I.

The crown or ring forming the chimney-holder supports (1) a truncated cone G, which may be integral therewith, and having either a straight or curved surface, and (2) another truncated cone of the same shape as the cone G, but preferably about double its height, with a small space between the two. The latter may be supported on the chimney-holder as in fig. 1, by means of three or more narrow brackets or fingers, so as to allow of the free circulation of air between the cones G and E; or it can be supported by an offset or shoulder formed on the chimney-holder as in fig. 2. The chimney holder or crown may, for this purpose, be provided with openings around its circumference, as in fig. 2, so that the external air may enter the space between or about the cones G and E. At the top of the inner cone E, a cap A of metal or other material is adapted to be heated to incandescence. Besides, within the cone E is arranged a dome-shaped wire-gauze screen F, the object of which is to render the mixture of gas and air burning within the cap A uniform and homogeneous, and at the same time to prevent the igniting mixture formed in the manner already explained from coming into contact with the incandescent cap, and, on being ignited thereby, burning within the apparatus. This screen is an essential feature of the apparatus; and the patentee particularly points out in this connection that, in the arrangement described, the mixture of gas and air always burns upon the outer surface of the cap or dome A, and never within it, which constitutes a striking distinction between the operation of this burner and other incandescent burners.

The space left between the two cones G and E is to admit a current of air between them, so as to prevent their being heated to an excessive degree; while, on the other hand, this current of air also supplies the oxygen necessary for the complete combustion which takes place on the surface of the incandescent dome or cap.

The cones E, D, and C, and the vessel or chamber J K L, may preferably be made of porcelain or metal; and the cap or hood A, which is to be heated to incandescence, may be made of a suitable metal—such as platinum, palladium, iridium, or the like—or any alloy of such or other metals, or of magnesia, or other suitable material. The number of cones may vary according to the effect it is desired to obtain; and their surfaces may be straight, as in fig. 1, or curved as in fig. 2.

Fig. 2 shows a burner constructed for small supplies of say 100 to 200 litres per hour. The two upper cones E and G are separated from each other by a series of openings provided in the crown or chimney

holder. Against these openings a correspondingly perforated ring P is arranged, capable of a slight turning motion, whereby the amount of air sucked in by the chimney draught between the cones G and E may be controlled. This control of the draught correspondingly affects the air supply through the openings of the lower chamber or vessel, so that the respective quantities of air may in every part be regulated at will. By surrounding the chamber just mentioned by another external chamber or casing, which may or may not be surmounted by a glass chimney, the apparatus can be rendered suitable for recovering heat, and the burner be fed with heated air.

Lamp Posts or Columns.—Pitt, W., Carter, H. J., and Aynsley, J., of Tottenham. No. 13,060; Aug. 20, 1890. [6d.]

The patentees propose to manufacture lamp posts or columns by arranging several lengths of wrought-iron bars approximately parallel and symmetrically around a centre, and fastening them together by casting collars upon them at intervals.

Charging Inclined Gas-Retorts.—Braidwood, J. F., of Greenwich. No. 15,388; Sept. 29, 1890. [1s. 1d.]

This invention relates to the charging of sloping or inclined gas-retorts, so that by its use the retorts can "be placed at a much greater angle—say, 36° or thereabouts."

The method consists in arranging one or more tilting-boxes, so mounted that, by the movement of a lever, the door at the front is opened, and the tilting-box released and commences to tip. The speed at which the box is allowed to tip is regulated by an air or pneumatic cylinder, attached to the tilting-box. By this means it is claimed that "a steady flow of coal at the required speed is admitted into the retort, where it distributes itself equally throughout."

Fig. 1.

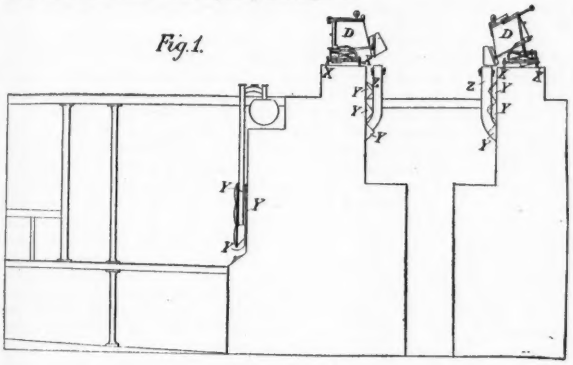


Fig. 2.

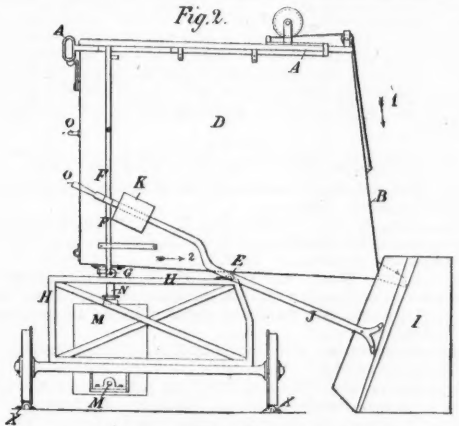


Fig. 3.

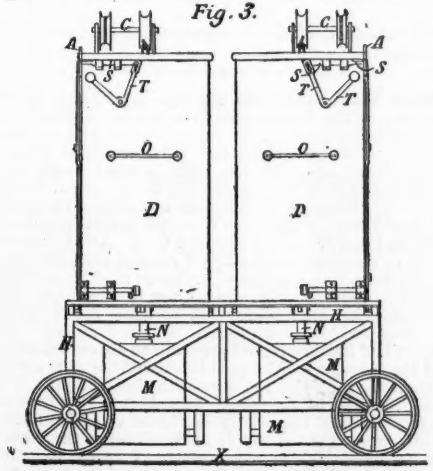


Fig. 1 is a view of a range of sloping retorts Y, showing two tilting-boxes (or receptacles for holding the charge of material), mounted in the form of tilting-waggons or trucks running on rails X laid above the retorts; the tilting-box D on the left-hand side being shown in its normal position, while that on the right-hand side is "tilted"—in the act of tipping the charge of coal into a retort. The coal is conducted from the outlet of the tilting-box to the mouth of the retort in the case illustrated, by means of a conducting shoot Z of special construction—which shoot forms the subject of a patent bearing date June 26, 1891, No. 10,902*—or in any other suitable manner. Fig. 2 is a side view, in elevation, of the tipping-waggon; and the patentee mentions that he finds it convenient to arrange two tilting-boxes on each truck or carriage running on the rails X. Fig. 3 is a side view, in elevation, of the waggon, showing the backs of the two tilting-boxes.

By pulling the lever A, the outlet-door B of the tilting-box is raised by means of a cord or chain, actuated by a pulley-wheel, which, in its turn, is actuated by another pulley-wheel, both being mounted and fixed on the same axis C. The last-named wheel is actuated by the returned end of the lever A; so that when it is pulled out from the back by the operator (as in fig. 1), it will thereby pull up the outlet-door B, and the coal will commence to discharge. The same movement of the lever that opens the door releases the catch that holds down the box D, and allows it to commence to oscillate on its bearings or axes at E (fig. 2) in the direction shown by the arrow marked 1. This release is effected by a shoulder or fixed projection on the lever A (see fig. 2), which, when it is drawn back, engages the upper end of the side lever F, which latter swings on its axis, and so moves the lower end in the direction of the arrow marked 2. This disengages it from the catch G on the truck framework H, and leaves the box D free to tilt over in the direction of arrow 1. I is a shield or guard mounted on the lever arm J, having a counterbalance weight K thereon; the shield being dropped down (as in fig. 2) before tipping is commenced, so as to prevent the coal (as it is being tipped down the guide) from scattering about. To prevent the box D suddenly overbalancing on its axis when released by the catch lever F, and to govern the speed of tilting, the pneumatic cylinder M is mounted in the carriage framework H, and is free to oscillate therein on trunnions (or other suitable bearings) turning in brackets on the framework. The piston-rod N of this pneumatic cylinder is connected direct to the under side of the tilting-box D, as shown in fig. 3. A suitable valve controls the speed at which the air (or it may be gas) is allowed to escape from the cylinder; the size of the valve being capable of being varied as desired, so as to regulate the speed of the piston. Thus, when the operator has once pulled the lever A, and released the tilting-box, the speed of tipping is regulated automatically and entirely by the pneumatic arrangement described, and in no way depends upon the skill of the workman.

When the coal has all been discharged from the box D, the workman (by means of the handle O placed on the back of the box or receptacle D) pulls down the tilted box into its normal position, as in fig. 2. The emptied box is readily restored from the tilted position to the normal—as the air rushes freely into the cylinder M through the inlet-valves in the piston contained in the cylinder M, the bottom of the cylinder being left quite open if desired. As soon as the box is brought again to its normal position, the lever A is pushed back by the workman; and the second projection thereon forces the side lever F back again, so that its lower end once more engages the hook or catch G, and so holds down the box upon the carriage frame H. S (fig. 3) is a safety bolt, which locks the lever when the box is in its normal position; the bolt being automatically actuated by the weighted arm or bell-crank T, which has a weight on its free end, thereby always keeping the bolt pressed outwards towards the lever in a slot in which it automatically engages when the lever is not drawn out.

Charging Inclined Gas-Retorts.—Coze, A., of Rheims. No. 16,213; Oct. 11, 1890. [8d.]

This invention relates to improvements in patent No. 7563 of 1885, in which each retort is provided with a separate shoot; the object of the present invention being to render a single shoot capable of serving the whole of the retorts of a bench in which the retorts are on different levels. For this purpose a shoot is employed, the lower end of which may be brought to correspond with the mouth of each retort to be charged; while at the same time one of several openings with which the shoot is provided corresponds with the feed hopper outlet. The arrangement thus comprises an adjustable shoot; a fixed or moveable charging-mouth; and a hopper-truck.

Fig. 1.

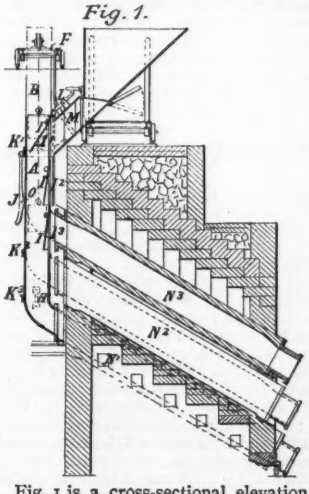


Fig. 2

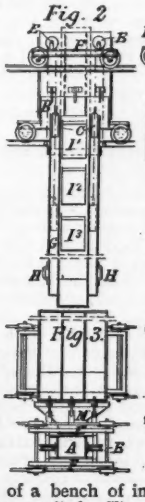


Fig. 4.

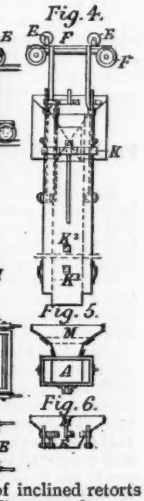


Fig. 5.

Fig. 6.

Fig. 3.

Fig. 1 is a cross-sectional elevation of a bench of inclined retorts with this improved charging apparatus applied. Figs. 2 and 4 are

* The specification of this patent has not yet been issued.

elevations, and fig. 3 is a plan of the charging apparatus separately. Fig. 5 is a horizontal section of fig. 4. Fig. 6 is an elevation of the charging-hopper.

The apparatus comprises a shoot A, of rectangular or other section, suspended vertically by chains B, and counterbalanced by weights C; the chains passing round guide-rollers E, mounted upon a truck F travelling on rails above the retort. The shoot, being balanced by the weights, which slide up and down in guide-ways G, can be raised and lowered by means of the handles H. The shoot is provided on the side next the retort with flap-valves I; and it terminates at the bottom in a bend adapted to correspond with the mouths of the retorts. The shoot is supplied from hopper-trucks running on rails laid along the top of the bench of retorts, and brought opposite the inclined charging-mouth M, fixed, in the present example, to the truck from which the shoot is suspended, to enable each of the trucks to be put in communication with the shoot. The trucks may be divided into three compartments, each of sufficient capacity to contain a charge for one retort; the compartments being provided with a false bottom held closed by a latch capable of being readily released by the lever L to discharge the contents of the compartment into the shoot.

In fig. 1 the apparatus is shown as applied for charging the lowermost retorts N^1 of the bench; the shoot A being here supported in position by a stop K^1 fixed on the shoot, and resting on a strap encircling the shoot, and attached to the charging-mouth M. The shoot is locked in its other position—that is to say, for charging the retorts N^2 N^3—by stops K^2 K^3 on the shoot engaging with a notch O of a lever J hinged to the strap above mentioned. The shoot has as many openings I^1 I^2 I^3 as there are tiers of retorts. These openings are placed at the same distance apart as that which separates the tiers of retorts; so that communication between the hopper truck may be established with either tier. In the case of benches of retorts placed back to back, the shoot is adapted to be rotated so as to serve both benches.

Street and other Lamps.—Waddington, W. C., of Manchester. No. 16,255; Oct. 13, 1890. [8d.]

This invention, which relates principally to lamps used in the lighting of streets and thoroughfares, is an improvement on patent No. 15,438 of 1884, where air admitted to support combustion entered through finely-perforated conduits, in order to ensure a steady light. In the present invention, the air is admitted through inlets, each provided with valves, which tend to close at times when there would be too strong an inrush of air—as, for example, during gusts of wind.

Fig. 1.

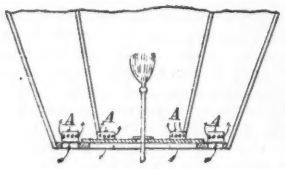


Fig. 2.

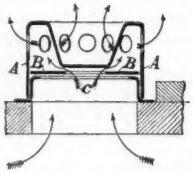


Fig. 1 is a vertical sectional view of the lower part of a lamp; and fig. 2 is a sectional view of one of the improved air-inlets.

A are six air-inlets (each of the form illustrated in fig. 2), made in three parts, A B and C. C is an annular dished piece, formed with an air passage, which is only slightly less in diameter than the cylindrical part; so that there is left a narrow annular edge upon which the valve B sits. The part A, which fits tightly upon the ring C, is in the form of a cylinder open at one end, and having its closed end deeply dished inward, so that an annular air passage is formed. The outer cylindrical wall A and the dished part are both perforated, so that air can escape freely from the annular passage, as indicated by the arrows. Between the flat bottom of the dish and the top edge of the ring there is a little space for the play of the valve B. This valve consists of a disc of thin sheet metal, in which is formed a central opening, considerably less than the opening in C, and a little less than the flat bottom. The valve B must be very light, so that a strong gust of wind will lift it from its seat; and the patentee therefore prefers to make this part of thin sheet copper or nickel, or of talc, or of a material which will not oxidize or deteriorate to such an extent as to interfere with the action of the valve. Owing to the comparatively large area which the valve exposes to the upward-flowing current of air, the valve will be lifted from its seat by a strong air current; and when so lifted, the opening in the valve will be closed or restricted by the bottom of the dish, so that strong gusts of wind are prevented from passing into the interior of the lamp.

Producing Gases from Bituminous Fuel.—Ross, F. E., of Croydon. No. 16,846; Oct. 22, 1890. [8d.]

This invention relates to the production of a mixture of carburetted hydrogen or gaseous hydrocarbons and producer gas from bituminous fuel in such a manner as to avoid the formation of easily condensable hydrocarbon vapours, and also to prevent the accumulation of clinker from the ashes or non-combustible portion of the fuel.

For this purpose the bituminous fuel (for example, coal) is charged into a gas producer, and distilled by the heat due to the combustion of the gaseous fuel forced into the upper part of the producer; the distillation being effected at such a temperature that very little, if any, condensable hydrocarbon vapour will be produced. The illuminating gas thus obtained, consisting of carburetted hydrogen and other hydrocarbons, together with the products of combustion from the gaseous fuel, descend through the incandescent mass of coke resulting from the bituminous coal previously distilled; so that any condensable hydrocarbons that may have been produced during the distillation will be decomposed, and converted into a fixed or non-condensable gas, and the carbonic acid gas in the products of combustion will, by combination with the carbon of the coke, be converted into carbonic oxide. The gaseous hydrocarbons, carbonic oxide, and other gases thus obtained, can be led either directly to a furnace or other apparatus where they are to be utilized, or to a gasholder. To prevent the formation of clinker, the height of the charge in the producer and the temperature of distillation are so regulated that the process of gasification of the coal by distillation and by combination with carbonic acid, shall not be complete until the gases reach a zone where the temperature is too low to effect the fusion of the ash. The gaseous fuel, and the air to effect its combustion, may be forced into the combustion or distillation chamber of the producer by any suitable means, such as pumps or blowers, or a steam-jet; or an air-jet may be used for the purpose. The gas burned in the combustion chamber of the producer may be part of that made therein, or it may be made in a separate auxiliary producer.

The producer has at the top a charging hole surmounted by a hopper with a charging cone; and also a lateral inlet for a mixture of gaseous fuel and air, or air and steam. At the bottom, the producer has a grate, a main outlet for the gases produced, an outlet through which a portion of the gases can be withdrawn for combustion in the upper part of the producer, as hereafter explained, and an opening normally closed by a door, and serving for the removal of ashes. Connected with the producer outlet is a box or casing, provided with a perforated rotary disc or regulator, a conical air nozzle, and a steam-pipe.

The producer being charged with bituminous fuel, ignited at the bottom, air is caused to flow through the air regulator and nozzle by a steam-jet, and to descend through the mass of fuel in the producer; the outlet-valve at this time being closed. The producer gas thus obtained is led away for use. When the mass of fuel is well ignited, a fresh charge of bituminous coal is introduced, and the outlet-valve opened. The producer being now in action, steam flowing in will cause part of the gases produced in the apparatus to flow from the bottom of the producer, and be mixed with air drawn through the air regulator and nozzle; and the combustible mixture thence passes into the distillation chamber, wherein it is completely burnt. The steam, when used, will be converted into water gas, which will mix with the other gases produced.

The supply of combustible gas, air, and steam is regulated by valves, so that the heat caused by the complete combustion of the combustible mixture will produce a temperature in the distillation chamber of (say) from about 1500° to 2000° Fahr., or such as will cause the distillation of the charge of bituminous coal, and the production therefrom of carburetted hydrogen and other hydrocarbons such as are usually produced for illuminating purposes by the distillation of bituminous coal in externally-heated retorts; the temperature moreover being such as to prevent, or nearly so, the formation of easily condensable hydrocarbons. The carburetted hydrogen and other gases thus obtained descend through the incandescent mass of coke, and any condensable hydrocarbons that may be present therein will be decomposed and converted into a fixed or permanent gas; and the carbonic acid gas produced by the complete combustion of the gaseous mixture introduced into the distillation chamber will be converted into carbonic oxide. By this means, during the working of the apparatus, the coke produced by the distillation of the coal will be gradually converted into gas. The carburetted hydrogen, carbonic oxide, and other gases thus obtained in a continuous manner, escape by the outlet, except such portion as is drawn away for combustion in the distillation chamber. With a height of charge of about 3 feet, and a temperature of about 1500° to 2000° Fahr. in the distillation chamber, the temperature of the lower portion of the mass of coke will be too low to effect fusion of the ash and consequent corrosion and clogging of the grate. The working of the apparatus, it is claimed, will thus be rendered easy and regular.

APPLICATIONS FOR LETTERS PATENT.

15,531.—Holmes, W., "A brass or iron plug tap applicable to street lamps and the like." Sept. 14.

15,552.—Orr, R., and Sutherland, R. M., "Improvements in and relating to retorts for distilling shale and like minerals, and for dealing with the resulting products." Sept. 14.

15,565.—Rives, C. G., and Rives, G. P. G., "Improvements in apparatus for automatically shutting off water or gas." Sept. 14.

15,664.—Ulmann, R., "Improvements relating to revolving pipe joints." Sept. 15.

15,778.—Gilbert, A., and Mansfield, A., "Improvements in gas stands for heating irons." Sept. 17.

15,785.—Imray, O., "Improvements in regenerative and other gas furnaces." A communication from C. Spaeter. Sept. 17.

15,823.—Morison, D. B., "Improvements in flanges for pipes." Sept. 18.

15,921.—Parkinson, W. C., "Improvements in gas-fires and gas-stoves." Sept. 19.

Teignmouth Local Board Gas Supply.—Last Thursday week, at a special meeting of the Teignmouth (Devon) Local Board, the Clerk reported a decision of the Board at the previous meeting, with reference to the extension of the gas-mains and the lowering of the price from 4s. 2d. to 3s. 9d. per 1000 cubic feet. Mr. Stooke thought they should have the electric light in the town before the proposed arrangements were carried out. He was sure this could be managed; and the present gas-works would be quite sufficient to supply private people, while the price would be lower than at the present time. The Chairman said it would be more convenient if the Board reduced the price of gas; but after that was done, the extension of the works would have to be undertaken. Mr. Stooke believed it was unwise to lower the price of gas before the extensions took place; but he again asked the Board to consider if they could have the electric light in the town. The Chairman stated he had had correspondence with an Electric Lighting Company; and the Manager said he would come and see what arrangements could be made for supplying the town with electric light. It was then decided that the price of gas should be reduced; that the Committee should be recommended to expend £6000 in the extension of the works; and that the question of the supply to Shaldon (on the other bank of the River Teign) should be also considered in the estimate. The question of the electric light was discussed; and it was resolved that an electrician should be asked to meet the Board to explain the probable cost of the light.

CORRESPONDENCE.

[We are not responsible for opinions expressed by correspondents.]

Gas Companies' Capital and Dividends.

SIR,—You say in last Tuesday's JOURNAL that, "if Mr. Livesey thinks the occasion ripe for a general revision of the scale of gas companies' statutory dividends, and a reconsideration of the subject of premiums, we shall be happy to accommodate him with reasonable space for the purpose. But it must be discussed in a free and general way." To this I beg leave to say that I certainly am of opinion that gas legislation *does* require reconsideration, and especially at the present time; and that I will gladly avail myself of your offer, within a week or two, to explain my reasons why. Discussion on any subject must be "free and general," or it is no discussion at all. Without going into the general subject now, there are one or two points to which, with your permission, I will call attention at once.

The Gas-Works Clauses Act, 1847, was passed for the purpose of placing under uniform regulations all gas companies having Acts of Parliament; and in all Acts passed since that date, it is incorporated. This Act limits the dividends upon original capital to 10 per cent., and provides that, when they reach this rate, there shall be a reduction in the price; and it authorizes the companies to create, out of their profits in excess of the 10 per cent., a reserve fund equal to one-tenth part of the nominal capital, to meet any extraordinary claim or demand which may at any time arise against the company. The 10 per cent. continued in operation for some time; but when the dividends became reasonably secure, as the Acts to some extent gave the companies a monopoly of their districts, the 10 per cent. was thought too high; and thereupon it was reduced to 7 per cent., which gave the consumers the advantage of 3 per cent. The 7 per cent. then continued in operation for several years more, when another regulation was introduced, requiring all new capital to be sold by auction, and the premiums to be applied to capital purposes, the same as the capital itself, but without bearing dividend; and this has gone on to the present time. The effect of it is that, whether the shares are 10 or 7 per cent., the sales realize the same proportionate premiums—that is to say, £100 at 10 per cent. sells for £200, and £100 at 7 per cent. sells for £140. So that the dividends in each case are only 5 per cent., although they are declared at 10 and 7 per cent. respectively. The consumers therefore suppose that the companies are paying that rate of interest upon all the money invested in their undertaking; whereas in fact it is only 5 per cent.

The Special Acts provide that the premiums shall be invested in the undertaking, but without dividend. But is not this a deception in itself? The premiums are invested in the undertaking the same as the nominal capital; and the profits are made upon the amount invested, and not upon an imaginary amount. In selling an undertaking, if the vendor described it as yielding 10 per cent. upon £100 when it was, in fact, only 5 per cent. upon £200, he would be guilty of gross misrepresentation, if not something worse. If, instead of £100 at 10 or 7 per cent., the companies took powers to issue a larger amount at 5 per cent., they would only have the same dividend to pay, while the consumers would understand what they are actually charged with, and much dissatisfaction would be avoided.

Under the Gas-Works Clauses Act, the companies are allowed to create a reserve fund, and by their Special Acts to borrow up to certain portions of the paid-up capital; but when one-half of the amount is raised as premium, and only the other half as capital, the reserve fund and borrowing powers are necessarily reduced in like proportion.

Under the sliding scale, when there is an increase of dividend, the 7 per cent. receives precisely the same in amount as the 10 per cent.—that is, 5s. for every 1d.; and thus, if the increase were 1 per cent., the 10 per cent. would get £5 10s. per cent., while the 7 per cent. would get £5 12s. But if the 7 per cent. received only the same rate as the 10 per cent., the proportion would be only £5 2s. per cent. This difference is not noticed while the expenditure is small; but it must in time become serious. I had a case last session in which a company under the sliding scale applied for more capital; and I advised them to take the additional capital at 5 instead of 7 per cent., and to provide that, in the event of there being an increase of dividend, the 5 per cent. should only receive 2s. 6d. instead of 5s. for every penny, so as to make the increase of dividend upon the 5 per cent. the same in proportion as it is upon the 10 per cent., instead of being, as now, the same in amount. I pointed out that, by adopting this course, they would have a larger paid-up capital, and consequently a larger insurance fund, and save both themselves and the consumers from the absurdity of having to pay the same increase of dividend upon 7 as they now do upon 10 per cent.; and I am pleased to say they agreed to do so, and the Bill passed in that shape.

W. LIVESEY.

76, Palace Chambers, Westminster, S.W.,
Sept. 25, 1891.

The Jubilee of the Belfast Water Commissioners.—The Belfast City and District Water Commissioners are about to commemorate in a befitting manner the fiftieth year of their existence as a Trust. They have secured for the hall of their offices in Royal Avenue, a massive tablet in brass, manufactured by Messrs. Singer, of Frome, on which are inscribed the names of the twelve Commissioners in office half a century ago, and the fifteen, together with the name of the Secretary, who now manage the affairs of the water undertaking. The tablet measures about 6 ft. by 4 ft., and is a work of art.

Gas Explosion at Colchester.—Last Sunday week, two houses in St. John Street, Colchester, were partially wrecked by an explosion of gas. It appears that Mrs. Wilson, who occupies No. 18, went into the dining-room to light the gas, and immediately she struck a match a terrific explosion took place. The house was so much wrecked that it was pronounced unsafe; and the walls of the next house were split in many places—the partition walls being entirely shaken down. It was found that Mrs. Wilson's left hand was slightly burnt; but, with the exception of a severe shock, she was otherwise uninjured. Fortunately, no one else was in the building at the time.

MISCELLANEOUS NEWS.

ALLIANCE AND DUBLIN CONSUMERS' GAS COMPANY.

The Half-Yearly Report and Accounts.

In the report to be presented by the Directors of the above Company at the half-yearly general meeting to-morrow, they state that they consider the results of the working in the six months ending June 30 last satisfactory, as compared with the corresponding period of last year, when it was found necessary to draw on the reserve fund to the extent of upwards of £8000 to pay the usual dividends, more especially as there had been an increased expenditure for wages, cannel, and coal, amounting to £7837, while there has been a reduction of £1934 in the receipts for tar and ammoniacal liquor. The Directors have entered into contracts for twelve months' supply of coal and cannel, commencing on the 1st prox. Although higher than under the existing contracts, the prices are considerably below those which the Company would have had to pay had they not been under contracts not quite expired. There has been placed to the credit of the capital account the sum of £14,341 1s. 1d. received from the Corporation of Dublin for the purchase by that body of the public lighting plant, less the costs of the arbitration (£491 16s. 4d.); the plant having been originally charged to capital. The whole of the works of the Company, including the distributing apparatus, have, it is stated, been kept in a condition of efficiency. The accounts annexed to the report show that the gross receipts amounted to £126,029, and the expenditure to £91,776; leaving a balance of £34,253. From this sum there has been deducted £5142 to pay interest on loan capital, &c.; leaving a net profit of £29,111 on the six months' working. To this has been added £4770 carried forward from the previous half year; making the total sum available for division £33,881. The Directors recommend the payment of dividends at the rates of 10½ and 7½ per cent. per annum on the respective shares; after which a sum of £24 will remain to be carried to the next account. The working statements show that 59,938 tons of coal and cannel were carbonized in the period covered by the accounts. From this bulk of raw material, 606,068,000 cubic feet of gas were produced, of which 537,312,000 cubic feet were accounted for. The residuals were as follows: Coke, 73,096 chaldrons; breeze, 6451 chaldrons; tar, 602,261 gallons; ammoniacal liquor, 1,300,306 gallons, worked up into sulphate of ammonia.

SHREWSBURY GAS COMPANY.

The Annual General Meeting of this Company was held last Wednesday—Dr. A. G. BROOKES in the chair.

The SECRETARY and MANAGER (Mr. W. Belton, Assoc. M. Inst. C.E.) having read the notice convening the meeting, the report and accounts were presented. In the former the Directors stated that the available balance of profit amounted to £5584, out of which they recommended that the authorized dividend should be declared. The reserve fund now amounts to £7470; and it is invested in Consols. There was a considerable increase in the consumption of gas during the year ending June 30 last, and a small addition to the net returns from residuals. The accounts show that the receipts were £24,503; and the expenses, £19,250—leaving a balance of £5253. There were 13,867 tons of coal and cannel carbonized; the residuals being: Coke, 7800 tons; breeze, 520 tons; tar, 881 tons; ammoniacal liquor, 1793 tons. The unaccounted-for gas was only 4·08 per cent.—the lowest rate ever attained by the Company.

The CHAIRMAN, in moving the adoption of the report, said the shareholders would perceive that it had not been necessary to increase the capital account during the year; and the Directors did not anticipate that they would be required to do so in the coming twelve months. But he would make this observation in relation to the matter—that, in the event of the consumption of gas going on increasing in the same ratio as it had recently done, they would be compelled to consider what they should do, as the works could not go on without a little further extension. He could hardly imagine, however, that the increase would continue as in the past year, as it had really reached an extraordinary amount. The additional make had exceeded 6·1 per cent.; while the sale had increased 8·5 per cent. This led to a very interesting fact in relation to the unaccounted-for gas. Last year it was a little in excess of what it was in the previous year; but now it had been reduced to almost a minimum. There were very few gas companies in England that could boast of such a small loss in unaccounted-for gas as their Company could, as it was only 4·08 per cent. They must bear in mind that this result was owing to the uncommonly careful supervision of their Manager. There was no source of loss but what had been carefully traced, and reduced to a minimum. They had had one drawback in their career, about which, unfortunately, most gas companies in England were complaining. He referred, of course, to the high price of coal. If it were not for this, consumers of gas would find that article cheaper, and there would be many other advantages resulting from it; but until a reduction took place, the Directors, who had to conduct their affairs with due efficiency and economy, could not recommend any alteration in the price. In spite of this drawback, however, they were in a position to pay a dividend without trenching upon the reserve fund, which was now nearly approaching the maximum—£8000—beyond which amount the Directors could not go. From whatever point of view they looked at the position of the Company, things were very satisfactory indeed. But in addition to the drawback to which he had alluded, there was another, and it was that the residuals were not yielding so good a return as heretofore. Whether these would increase again or still further diminish, he could not tell. He might say, in respect to sulphate of ammonia, that the Company had been making it; but, in consequence of certain difficulties that had arisen, they had temporarily given it up, though they hoped to be able to resume the work again when they could discover the means of carrying it on without its being in any way a nuisance that could be complained of, or, indeed, without producing any nuisance at all.

Many improvements had been adopted within the last few years; and here again he must compliment their Manager upon the care with which he judged of the probability of success attending any improvement he introduced. They had been very successful; and Mr. Belton's ability had enabled him to make gas of greater purity and higher lighting power, while reducing it to an almost odourless condition.

Mr. BENTLEY seconded the motion, and it was carried unanimously.

The authorized dividend of 7½ per cent. per annum having been declared, the retiring Directors and Auditor were re-elected.

On the motion of Mr. T. F. POOLE, seconded by Mr. R. TAYLOR, a vote of thanks were accorded to the Chairman and Directors for the careful attention they had bestowed upon the affairs of the Company.

The CHAIRMAN, in reply, said the Directors paid unremitting attention to the affairs of the Company; and although the merit of conducting the works was due to their Manager, the success attained by the Company was, in some measure, attributable to the supervision of the Board.

Mr. BENTLEY proposed a vote of thanks to Mr. Belton for his able and efficient management of the affairs of the Company, and also to the several officials serving under him for their hearty co-operation.

The proposition was carried, and Mr. BELTON replied.

A vote of thanks to the Auditors was then passed, and the proceedings closed.

OTTOMAN GAS COMPANY, LIMITED.

The Ordinary Meeting of this Company was held last Tuesday, at the Offices, 9, Queen Street Place, E.C.—Mr. E. HORNER in the chair.

Mr. T. GUYATT (in the absence of the Secretary, Mr. Arthur J. King read the notice convening the meeting; and it was agreed to take as read the report of the Directors and the statement of accounts for the half year ending June 30 last, a reference to which appeared in the JOURNAL for the 15th inst. (p. 492).

The CHAIRMAN said that there was very little to bring before the shareholders, seeing that the revenue account furnished all the necessary information. He might, however, mention that the price of coal had been £1 4s. 2d. per ton, as against £1 0s. 6d. This had caused an increased expenditure amounting to more than £500; but, of course, it was entirely beyond the control of the Board. The profits of nearly all other gas companies had been affected in the same way; but he was glad to say that the present cost of coal and freightage was much more favourable, and, he hoped, would enable them to present a better statement at the next meeting. The other items in the accounts stood very much the same as in previous half years; and therefore he would, without further remarks, move the adoption of the report and accounts.

Mr. A. J. DOVE seconded the motion.

Mr. R. HESKETH JONES said it seemed to him, comparing the present accounts with those for the corresponding half of last year, that the revenue derived from private consumers had slightly decreased. Of course, the Directors were not responsible for this; but it struck him as not being very satisfactory.

The CHAIRMAN observed that the trade of Smyrna had been very bad indeed; and there was no doubt that to this was largely due the reduced consumption of gas.

The motion was carried unanimously.

On the proposition of the CHAIRMAN, seconded by Mr. DOVE, a dividend was declared, on both classes of shares, at the rate of 7 per cent. per annum, free of income-tax.

The CHAIRMAN said he did not think the shareholders should separate without passing a vote of thanks to their Consulting Engineer (Mr. H. W. Andrews), the Engineer and Manager (Mr. John Gandon), and the staff, all of whom had done a great deal for the Company. According to a report which the Board had received that morning, the Company's prospects were very good; and what was being done by their representatives at Smyrna would be of considerable value to them in getting their concession extended.

Mr. HORATIO BROTHERS seconded the proposition, which was carried.

Mr. JONES then moved a vote of thanks to the Chairman and Directors.

Mr. R. L. ANDREWS, in seconding the motion, observed that he was sure the shareholders all felt the loss which the Company had sustained in the death of one of the Directors (Mr. Stephenson Clarke); and it was with much satisfaction that they learnt that Mr. Clarke's eldest son had been elected to fill the vacancy on the Board.

The CHAIRMAN, in responding on behalf of himself and his colleagues, remarked that the Directors felt very keenly the loss of Mr. Stephenson Clarke, who had been of very great assistance in conducting the affairs of the Company.

The proceedings then terminated.

LINCOLN CORPORATION GAS AND WATER SUPPLY.

Annual Accounts.

The City Treasurer of Lincoln has issued his abstract of accounts for the year ending March 25 last, and the following figures relating to the Gas and Water Departments of the Corporation have been taken therefrom:—

With regard to the gas undertaking, the capital account shows a total indebtedness of £191,330—viz., capital value of gas annuities, £171,450; loan on mortgage, £8000; and loans paid off by the Lincoln Corporation, £11,880, including balance advanced by bankers. On the credit side the original cost of the undertaking is put down at £185,795; and the expenditure on the new buildings, new mains and services at £5334. The revenue account for the year gives a total of £33,406. The cost of the manufacture of gas was £17,266—viz., coal, £11,817; purifying, £661; salaries of officers at the works, £462; wages (for carbonizing), £2519; and repairs and maintenance of works and plant (including renewal of retorts), machines, &c., £1806. A sum of £1447 was paid for the distribution of gas, as follows: Salaries of meter inspectors, £161; repairs, maintenance, and renewal of mains and service-pipes, £905; repairing, renewing, and re-fixing meters, £381. Rents, rates, and taxes absorbed £793. A sum of £640 was expended in the purchase of gas cooking-stoves; and £172 was charged for expenses of the Corporation stock. The management expenses were £880, made up as follows: Salaries of Manager, Accountant, clerks, &c., £538; collectors, £185; printing and stationery, £51; incidentals, £33; Auditor, £25; and proportion of compounded stamp duty, £46. Interest on loans required, £225; and £1333 was needed for current liabilities—viz., for proportion of interest on loans and annuities. The interest on the Corporation stock amounted to £4303; there had been transferred to the sinking fund a sum of £1991; and the balance amounted to £4350. The credit side showed a balance from last year's account of £2213. The sale of gas brought in £22,507—viz., £20,786 for 166,288,300 cubic feet to private consumers; and £1721 for 13,771,000 cubic feet for public lighting, both at 2s. 6d. per 1000 cubic feet. The rental of meters yielded £553, and gas cookers, £188. For residual products a total of £7342 was obtained—viz., £4307 for coke and breeze, £1669 for tar, £1244 for ammoniacal liquor, and £121 for refuse lime. The sum of £489 represented the value of gas cooking-stoves on hire and in stock, after allowing for a depreciation at the rate of 20 per cent. There were 18,037 tons of common coal and 46 tons of cannel carbonized during the year. On March 25 there were 42,800 gallons of tar in stock, and 120 tons of coke and breeze. Attached to the abstracts is an appendix, which contains, among other things, a report by the Gas Manager (Mr. J. Carter). In this he says that the most prominent feature in connection with the manufacture of gas was the greatly enhanced price of coals; the cost being £11,817, an increase upon the figures of the previous year of £3114. The average cost per ton was 13s. 0·8d., or nearly 2s. 9d. per ton in excess of the price paid in the previous year. The distribution account showed an increased expenditure of £664, due to the new main laid for the supply of the County Lunatic Asylum. The increased total expenditure has, however, been largely met by augmented income. The sale of gas yielded £1583, and residuals £1213 more than in the preceding year. The gross trading profit was £9991, and after all the charges in relation to the capital and sinking fund were met, there remained a surplus profit of £2137. In the course of the year, 2310 yards of new mains had been provided and laid.

As to the Water Department, the water-rents yielded altogether £8917; £29 was allowed by the bankers as interest; and £10 was received from the Corporation for rent of land—making a total of £8956. The maintenance and working expenses amounted to £4195; the rents of reservoir, ballast-pits, &c., were £157; and rates and taxes absorbed £366. Interest on loans required a sum of £3966; and £1167 represented the amount paid on account of loans. A balance of £727 remained in the hands of the Treasurer, against £1623 at the beginning of the year. The capital account shows that the purchase of the water-works originally cost £63,827, and that £42,608 had been since expended in the purchase of land, the erection of new buildings, additions, and extensions. The gross amount of loans obtained on the undertaking was £105,000, of which £12,733 had been repaid by instalments. The general district rate account had also a sum of £3700 repaid out of the revenue. In his report in the appendix, the Water Engineer (Mr. H. Teague) states that the water-rents brought in £8927, and bank interest £29—total, £8956; being an increase of £297. The ordinary payments, including principal and interest, were £8387; leaving a balance of £569. The amount paid out of revenue during the year for new works was £1465, and since the transfer to the Corporation £2246 had been paid out of revenue. There were 9486 houses supplied with water—being an increase of 115. The quantity of water pumped was 385,549,912 gallons, or an increase of 4,940,848 gallons; the quantity wasted during the frost being 11,078,000 gallons.

THE INTRODUCTION OF GAS INTO NEW YORK.

A correspondent of the *New York Post* recently furnished to that paper the following particulars as to the introduction of gas lighting into the city:—

In the year 1697 the first resolution concerning the lighting of the town was passed by the City Government. Some crime must have been committed which disturbed the unprotected sleep of the people; for on the 20th of November, a city watch of "four sober, honest men" was ordered. The resolution, as recorded in the records of the Common Council, runs as follows: "Whereupon it is thought necessary by this Board that four sober, honest men be appointed to keep a watch in this City every night unto the 25th day of March next; and that they hourly go through the several wards of the city during the said time, in order to prevent irregularities." But this was not sufficient. The "four sober, honest men," however strong their authority might have been, were not of much avail if the city remained dark during the night. Thus, three days later the following resolution was adopted: "This Board, taking into consideration the great inconvenience that attends this city, being a trading place, for want of having lights in the dark time of the moon in the winter season, it is therefore ordered that all and every of the housekeepers within this city shall put out lights in their windows fronting the respective streets of the said city, according to such manner and rule as shall be directed by the Mayor, two Aldermen, and two assistants, under the penalty of nine pence for each night of default." On the 2nd of December of the same year, it was ordered "that every seventh house do hang out a pole with a lantern and candle, and the said seven houses to pay equal portions of the expense." In this way, by the co-operation of the inhabitants, the city was lighted, until, in 1761, the first public lamps were placed at an expense of £800.

The origin of the gas question dates back to 1813, when it is first mentioned in the records of the Common Council (Vol. XXVII., p. 163), where we find the following entry under Aug. 9: "The Lamp and Watch Committee, to whom had been referred to consider and report what improvements may be made in lighting the public lamps, reported that they have had an interview with Messrs. Ward and Tallman, and witnessed an exhibition of their gaslight. Of the superiority of this species of light over that produced by oil your Committee have no

doubt; but the propositions made by Messrs. Ward and Tallman are such as your Committee deem inexpedient for this Board to accept. Your Committee, being informed that the principle of lighting lamps by means of gas is not a secret confined to the above-named gentlemen, recommend that the Lamp Committee be empowered to make an experiment of the same, in causing the lamps in front of the City Hall, or such other place as they may deem proper, to be lighted in the manner proposed." It seems that this proposal was not acted upon. But others made experiments with the new light; and on Sept. 20, 1813, a request was read and accepted, sent to the Council by Mr. Gemmings, to view an exhibition of his gas in front of the Bridewell.

In the year 1816, frequent proposals for lighting the city with gas were made. Among them (on Jan. 29) was a communication of the Common Council of the city of Philadelphia on the subject of lighting the public lamps of the city with gaslight, to which the Mayor made a suitable reply. But none of these proposals had any practical effect, excepting that of one person. On June 10, 1816, a memorial of Dr. Robert Hare, from Philadelphia, was received, in which he stated that he was acquainted with the method of lighting with gas, and requested a conference with the Committee to whom the subject of lighting the city was referred.

This Committee, the Committee on Arts and Sciences, and the Lamp Committee reported on June 18. They expressed the opinion that gaslight might be extensively and usefully applied for the public benefit; and they give an account of how gas was manufactured, and when and how it was first used for lighting purposes. After referring to England and France, they said: "In the United States, experiments have been made to exhibit the brilliancy and elegance of gaslight; but till of late no application has been made of it to economical purposes. In consequence of a proposal made by a Mr. Henfrey in 1802 to illuminate the lighthouses on our coast with inflammable gas, the Secretary of the Treasury of the United States (Mr. Gallatin) made application to Dr. Mitchell—the representative of the City of New York in Congress—for information on this subject; and the latter gentleman recommended a trial to be made. But the plan was never carried into execution. Our countryman, Dr. James Mease, produced inflammable air from red cedar in the winter of 1802. The extensive museum of Mr. Peale in Philadelphia is entirely lighted by gas produced from pitch." Statistics were given of English factories where gas was being used, to show that it was cheaper than tallow or oil. The experience of London showed that it was also more profitable to light public streets with gas than with oil. The Committee went on to say: "In this way a considerable portion of the City of London is lighted with coal gas. Fifteen miles of main-pipe were laid down there in the beginning of the last year (1815). The economy of gaslight is so certain that an incorporated company of London was bound by its Charter to furnish a better and stronger light than oil, at a less expense, and yet obtained profits arising from the undertaking. Every one who has made use of this method of illuminating in Europe has found its economy surpass all expectation. It has been doubted, however, whether the economy of gaslights would be so great in New York as in Europe. The high price of labour, wood, and coal would certainly diminish the profits of the undertaking; and it is a matter of uncertainty whether the coke and other products of the distillation could be so readily disposed of as in Great Britain, and it is the sale of these that diminishes the expense. There has been before your Committee a calculation for an apparatus to supply 600 lamps, the expense of which is stated at $2400 outfit. To supply the whole city with apparatus and main pipes is estimated at $640,000. The annual expense to supply the gas for any part of the whole is not stated. But a plan for a less complicated machine than the one herein described has been laid before the Committee by Mr. Robert Hare, the expense of which is comparatively trifling, and it is not so liable to be out of repair. His estimation is as follows: Outfit, as detailed in his estimate, $3300; annual expenses, $2700; sources of income, $5100. From which deducting the annual expenses, leaves the net proceeds per annum $2400."

The Committee proposed the following resolution, which was adopted: "Resolved, that a Select Committee be appointed with powers to institute an experiment in gas-lights upon the plan under the superintendence of Mr. Robert Hare, and that a sum not exceeding $5000 be put at the disposal of said Committee to carry the same into effect, to be taken out of any moneys in the Treasury not otherwise appropriated." On July 22, $1000 were added to this appropriation. The experiments were made in an old building near the east corner of the City Hall, and temporary tin pipes were laid through Chatham Street and Broadway as far as Dey Street, and a few store windows were lighted. The light was much admired, and created great excitement among the population. On Nov. 18, the Common Council received a communication from Dr. Samuel Ackerly (one of the Aldermen), stating that "as the gaslight experiment had completely succeeded under the direction of a Committee of the Board," he had it in contemplation to deliver at Tammany Hall, on the evenings of the 21st and 23rd of that month, two lectures on inflammable air and its application to economical purposes explanatory of the system of gaslight, which he invited the members of the Common Council to attend; and in the *Gazette* of Nov. 22 was this notice:—

GASLIGHT.—Last week the large hall of Tammany Hall was first beautifully lighted by gas from a numerous variety of pipes, presented in elegant gilt figures, and exhibiting in different forms, arranged with taste and judgment, an abundance of pure and inoffensive light, without smell, smoke, want of attendance, or danger of conflagration. The store of Messrs. Haight, on Broadway, illuminated by the same vapour, attracts much notice every evening; and from the favourable reception this useful improvement meets with, we anticipate the employment of the whole length of pipes laid down by Mr. Hare as soon as the necessary apparatus can be prepared and properly fixed in the buildings to which it extends.

However, this was not done. The city authorities' eagerness was satisfied by the experiment, which cost $5297·25 (including $1400 for seven months of Mr. Hare's salary); and they shrank from the expenses of laying the requisite iron pipes, which would have cost for the whole city several hundred thousand dollars, as was then estimated. After this, all the applications and offers for supplying the city with gas remained without effect, until in 1823 the first Gas Company, called the New York Gaslight Company, was chartered, and by contract gained the right to light the city south of Grand Street.

METROPOLIS WATER SUPPLY.

The Quality of the Water in August.

The returns furnished to the Registrar-General by the London Water Companies as to the water supply of the Metropolis during the past month, show that the average daily supply was 185,973,866 gallons, as compared with 185,011,729 gallons in the corresponding month of 1890; being at the rate of 30·7 gallons per head of the population. Of the entire bulk of water sent out, 93,673,486 gallons were drawn from the Thames, and 92,300,380 gallons from the Lea and other sources. Reporting upon the quality of the supply, Dr. E. Frankland said: "Taking the average amount of organic impurity contained in a given volume of the Kent Company's water during the nine years ending December, 1876, as unity, the proportional amount contained in an equal volume of water supplied by each of the Metropolitan Water Companies and by the Tottenham Local Board of Health was: Kent, 0·9; East London (deep-well), 1·0; New River, 1·2; Colne Valley, 1·3; Tottenham, 1·8; Chelsea and East London (river supply), 2·4; West Middlesex, 2·5; and Southwark, Grand Junction, and Lambeth, 2·7. The water abstracted from the Thames by the Chelsea, West Middlesex, Southwark, Grand Junction, and Lambeth Companies maintained the improved quality which it exhibited last month. It was efficiently filtered before delivery. The water taken chiefly from the Lea by the New River Company was much purer than any of the Thames waters, and again ranked with the deep-well waters in respect of freedom from organic matter. The water supplied from the same source by the East London Company ranked with the best of the Thames waters. Both Companies delivered efficiently filtered water. The deep-well waters of the Kent, Colne Valley, and East London Companies, and of the Tottenham Local Board of Health, were all of good quality for dietetic use; and the Colne Valley Company's water, having been softened before delivery, was rendered suitable for washing. All these waters were clear and bright without filtration. Seen through a stratum 2 feet deep, the Kent, Colne Valley, Tottenham, East London (deep-well), and New River waters were clear and colourless; and the remaining waters clear and very pale yellow. The bacteriological examination by Dr. Koch's process of gelatine plate culture gave the following results: One cubic centimetre of each water collected in sterilized vacuous tubes, on the same days as the samples for chemical analysis, developed the following numbers of colonies of microbes: New River, 16; Southwark, 26; West Middlesex, 28; Lambeth, 42; Grand Junction, 46; Kent, 110; and East London (river supply), 208."

Messrs. Crookes, Odling, and Tidy, in their report for the past month on the composition and quality of samples taken daily of the water supplied to London, say: Of the 174 samples examined, all were found to be clear, bright, and efficiently filtered, excepting three, which were recorded as "very slightly turbid." Throughout the month of August, notwithstanding the excessive and often stormy rainfall, the character of the water supply to the Metropolis continued to be eminently satisfactory. The extreme degree of freedom from organic matter which characterized the supply of the previous month was fully maintained; and the effect of the storm rainfall was noticeable only in a slightly diminished degree of freedom from colour-tint, and in the occurrence of the three samples of water noted as "very slightly turbid." The maximum amount of organic carbon present in any single sample examined was only 0·128 in 100,000 parts of the water; corresponding to considerably under a quarter of a grain of organic matter per gallon. A comparison of the results afforded by the Thames-derived supply in the months of July and August respectively, with the mean results afforded by the previous four months' supply, is shown in the following table:—

	Ratio of Brown to Blue Tint. Means.	Oxygen required for Oxidation. Means.	Organic Carbon per 100,000 Parts. Means.	Organic Carbon per 100,000 Parts. Maxima.
Mean of previous four months	13·0 : 20	0·051	0·147	0·209
July	8·9 : 20	0·046	0·121	0·142
August	11·4 : 20	0·045	0·114	0·128

THE PROPOSED ADDITIONAL WATER SUPPLY FOR EDINBURGH.

Reference has lately been made by our Edinburgh correspondent to the schemes which the Water Trust have had before them for obtaining for the city an additional supply of water. In his "Notes" in the JOURNAL for the 8th inst., he stated that, in accordance with his prognostications, the Consulting Engineers to the Trust (Messrs. Hill, Gale, and Mansergh, MM. Inst. C. E.) had recommended the adoption of the Manor scheme, in preference to those under which the upper waters of the Tweed and St. Mary's Loch were to be utilized. The Treasurer (Mr. W. Anderson) prepared a statement showing the assessments necessary to meet the cost of the new works; and it was left for the Trustees to come to a decision on the matter. In the course of their report, the Consulting Engineers said:

At the time of making investigations in Edinburgh in October last with reference to the first part of your instructions, we visited the several suggested sources of supply at the head waters of the Manor, the Tweed, and St. Mary's Loch; and at the time of our recent visit to the districts, in the middle of July, we made a careful examination into the circumstances of each. On both occasions the streams were free from flood water; but the water in St. Mary's Loch at the time of the first visit was stained by peat from previous rain. The comparison of the cost of the schemes is estimated on the basis of a supply of from 15 to 16 million gallons per day being obtained. This is, in fact, more than doubling the present available quantity of water; or, in other words, making provision for a population double that now existing at the present rate of consumption—viz., 38 gallons per head

per day. We will now proceed to the consideration of the several schemes which have been suggested for examination.

The Manor Water is a large tributary of the River Tweed, and joins that river about two miles above the town of Peebles. The hills bounding the watershed proposed to be appropriated vary from 2200 to 2600 feet in height; and the drainage area consists principally of mountain pasture interspersed with rock and *débris*, and is practically free from cultivation. The water in the streams was on the occasion of both visits bright, clear, and free from stain. The rainfall is large, and the average available rain of three consecutive dry years will probably be about 26 inches per annum. The total drainage area which can be utilized is 13,720 acres, which, after providing compensation water to the stream, will yield a supply of about 15 million gallons per day for the city. The valley is favourable for the storeage of water; and the necessary storeage can be provided by the construction of two large reservoirs—one on the Manor Water at Posso, with a top water-level of 894 feet above Ordnance datum, and a capacity of 2703 million gallons, to be formed by an embankment of a maximum height of 92 feet; the other on the side valley on the Hundleshope Burn, with a top water-level of 727 feet above Ordnance datum, and a capacity of 1345 million gallons, formed by two embankments, one at each end of the reservoir, of about 52 feet and 38 feet in height respectively. The storeage thus provided is sufficient to maintain the supply to the city, and furnish the compensation water for a period of 180 days. The surface area of the two reservoirs will be about 450 acres to a drainage of 13,720 acres, or about 1 : 30.

The scheme can be conveniently carried out in two sections. The first would consist of the construction of the Posso reservoir, of the size already mentioned, which will receive the water from a drainage area, including the Glenrath Burn, of 9310 acres. The supply thus obtained for the city, after providing compensation water, will be about 10 million gallons per day. The second section of the scheme would consist of the construction of the reservoir in the side valley on the Hundleshope Burn, to which there would be a drainage of 4410 acres, including the drainage to the main stream below Posso, to be conveyed to this reservoir by an aqueduct about one mile in length. The Hundleshope reservoir will provide the compensation water for the whole drainage of 13,720 acres. The Posso reservoir would thus be wholly available for the city, and the supply to be obtained would be about 15 million gallons per day. The water would be conveyed from the Manor Valley to Alnwick Hill—a distance of about 25 miles—by an aqueduct, consisting of tunnel, cut-and-cover or built aqueduct, and cast-iron piping across the valleys. The aqueduct would cross the Tweed at Manor Foot, and follow the west side of the Eddleston Valley through the ridge at Leadburn by tunnel, thence alongside the Peebles Railway to the line of the Moorfoot pipe, and on to Alnwick Hill.

The estimated cost of the first instalment of the work for 10 million gallons per day for the city, including land and contingencies, with tunnel and cut-and-cover aqueduct for 24 million gallons per day, and one line of pipes for 15 million gallons per day, will be £602,364; and for the second instalment of 5 million gallons per day, £240,076; making a total outlay of £842,440 for the 15 million gallons of water a day.

For the purpose of comparison with the other schemes, we have made an estimate for a first instalment from the Manor of 8 million gallons per day, which amounts to £568,079; and the completed scheme for 15 millions, by this method of dealing with it, will cost £873,005. This includes tunnel and cut-and-cover aqueduct for 24 million gallons per day as before, but with a pipe to convey only 8 million gallons per day, and deducting the diversion of the Glenrath Burn, as the Posso drainage alone will give this quantity. The Manor Water is the nearest of the three schemes to Edinburgh, and is one of the best waters to be obtained. It has previously been looked upon as a likely source of future supply for Edinburgh, and was reported upon by the late Mr. Leslie in 1870.

In the Tweed scheme, the streams proposed to be utilized are the Talla Water, with Gameshope Burn, the Menzion Burn, and the Fruid Water. The drainage area which can be rendered available on these streams is 12,175 acres (the hills surrounding rise to a height of considerably more than 2000 feet). As regards the Talla, the ground is of very much the same character as described for the Manor scheme; but in the Fruid, the drainage area is less favourable. To provide 16 million gallons of water per day, would, it is estimated, cost £833,000. The St. Mary's Loch scheme is estimated to cost £879,000 for a supply of 15 million gallons per day.

Having considered the merits of the various schemes as set out in this report, and seeing that the Manor Water is the nearest source in point of distance to Edinburgh, that the water to be obtained is the best in quality, that Parliament some years ago sanctioned the appropriation of it for the supply of the Edinburgh district, and having regard to the cost of the first instalment being the least of any of the schemes, we strongly recommend the adoption of the Manor scheme.

At the Meeting of the Water Trust last Thursday—Lord Provost Boyd in the chair—the subject dealt with in the foregoing report was under discussion.

Bailie Archibald, Convener of the Works Committee, moved the following resolution: "The advising Engineers, having reported, under the first branch of their remit, that, under the circumstances set forth in their report, dated May 7, 1891, it is imperative that the Trustees proceed at once to provide for bringing in an additional supply of water; and, under the second branch of their remit, the advising Engineers, along with the Engineers of the Trust, having strongly recommended the Manor scheme as the best for providing an additional supply of water for Edinburgh and District, the Trustees having visited the district, and received explanations from the Engineers, and carefully considered the scheme, approve of the recommendation of the Engineers. The Trustees instruct the Clerk to transmit to the Corporations of Edinburgh, Leith, and Portobello a copy of this minute; stating that the Trustees will be pleased to have the approval of the Corporations to the scheme, and their support in carrying the measure through Parliament. That the Engineers be instructed to complete their plans to allow the parliamentary notices to be given, and a Bill prepared for the next session of Parliament, to be proceeded with in the event of the Corporations approving of the scheme." Speaking to his motion, he reviewed the whole of the circumstances in regard to the proposed additional supply of water since it had been under the consideration of the Trustees in September, 1888, at which time the Engineers of the Trust visited the Manor Valley and reported on it. He described what had been done with reference to the prevention of waste with the Deacon meters, and other means; quoted reports by Messrs. Leslie and Reid, the Engineers of the Trust, on the subject, and then went on to speak of the appointment of Messrs. Gale, Hill, and Mansergh to report as to the capacity of the existing works, the best means of checking waste, and the necessity of proceeding to bring in an additional supply of water. He said the practical result of the experiments for the prevention of waste showed that, upon the average, a supply of about 28 gallons per head per day for domestic use might be sufficient; but to this had to be added the water used for public and sanitary purposes and extinguishing of fires, also for the shipping and trade supply, which was estimated at about 10 gallons per head per day—thereby bringing up the total supply for all purposes to about 35 or 36 gallons per head per day. This was borne out by a report by Messrs. Leslie and Reid, the Trust's Engineers, in June, 1889; and they were of opinion that it would not be prudent for the Trustees to delay much longer in maturing a scheme for obtaining an additional supply. The Works Committee adopted this opinion, particularly as it would be seven or eight years before a new supply could be available. Was it absolutely necessary at present to proceed to obtain an additional supply of water? Taking the average delivery of water in the year 1880-81, which was 12,500,000 gallons a day, and the delivery in 1889-90, which was 15,200,000 gallons per day, this showed an increase during the last ten years of 2,700,000 gallons of water daily. But it might be said that a portion of this was in respect of towns and villages and houses which had been supplied in addition to the ordinary population. The supply for those places did not exceed 500,000 gallons per day, deducting which there had been an increase in the daily consumption within the limits of the compulsory supply during the decade of about 2,200,000 gallons daily, and as the average consumption at present was about 15,000,000 gallons, which was equal to the capacity of the works in average years, where, he asked, was the water to come from for the next nine or ten years to supply the increasing population and the increasing demand for trade and sanitary purposes? Only by saving the dribbles usually called waste. The Consulting Engineers had assumed in their estimate an increase of population for the next ten years at the rate of 15 per cent., being the average rate of increase over the last 20 years, which would make a population in 1901 of 421,430. This seemed to be wise, for, although during the last decade the increase had been only 11 per cent., during the former ten years the population had increased by about 20 per cent. The trade supply during the last ten years had practically trebled itself; but the Engineers had assumed that it would only double itself during the next period. If, however, the rate for trade supplies were reduced to 4½d. per 1000 gallons, in place of 6d. the increase would be much greater. He calculated that the supply for all purposes in 1901 would amount to 36·28 gallons per head, equal to a gross total delivery of water of 15,289,807 gallons per day. Assuming the population in 1901 to be only 406,779, which it would amount to at the same rate of increase as had taken place during the last census period—viz., 11 per cent., with the addition of the special supply, and domestic and sanitary supply kept down to the lowest point stated by the Engineers (24 gallons per head)—the total supply required in 1901, even at this modified rate of increase of population, would be 17,084,758 gallons daily. The foregoing statement clearly demonstrated the necessity of proceeding to augment the water supply; and the Manor scheme had been unanimously and strongly recommended. As to the quantity of water to be obtained from the Manor district, this was set down, upon an average period of three consecutive dry years, at about 15 million gallons per day; thus practically doubling the present population supplied, and was equal to about 37 gallons per head per day. This was surely looking far enough ahead. When the Manor supply became exhausted, those who lived at that time and were in charge of the affairs would have to go farther afield—either to the Tweed district or to St. Mary's Loch; and by constructing the Manor tunnel through the Leadburn ridge of the capacity of 50,000,000 gallons per day, any additional supply from these sources could be brought in. As to the cost, confining himself to the Manor scheme, the Treasurer's statement showed that there would be no increase in the domestic rate for the next seven years, and only an increase of 1½d. on the eighth year would be required. After that time they would have to set against the annual charge of £10,000 upon the capital expenditure of £70,000—the cost of the works—the increasing revenue from the new water supply, which would probably be not less than £3000 per annum, and there could be no need after that period, with such a large surplus of water, to incur £3000 a year for checking waste. Half of this might, at all events, be saved; and this would give them £4500 a year. Therefore any increase in the rates after that period could not be great and would only be for a short period. Having further considered the financial part of the scheme, he concluded by saying that the Trustees were advised by the most experienced Water Engineers in the kingdom that an additional supply of water would be necessary within a limited period, and that the Manor scheme was the one that should be adopted.

Mr. J. Walcot seconded the motion.

Mr. Colston then moved the following amendment: "The Trustees having regard to the fact that it is most desirable to carry public opinion along with them in the important question of a water supply, resolve to delay consideration of the subject until the three Corporations of Edinburgh, Leith, and Portobello shall have reported to their respective constituencies as to the necessity for an additional supply, and as to the merits of the various schemes dealt with by the Consulting Engineers, together with the relative expense and capabilities of each of these sources of supply; and when these have been fully ascertained, and a decision come to by the three Corporations, request the Town Clerks to transmit a copy of such resolutions to the Clerk of the Trustees. Further, the Trustees, in respect that up to the present time no representations have reached them from the ratepayers as to any want of water, instruct meantime that no additional expenses be incurred in the preparation of parliamentary notices and

plans until the Trustees have received the decision of the three Corporations." He said he concurred in much that had been stated by Bailie Archibald. He agreed with him in thinking that it was not long before they must have an additional supply of water, and that the best scheme they could have for the next supply was unquestionably the Manor. At the same time they should not go on forestalling public opinion, but should wait till the public expressed their views, which, he hoped, would be in favour of the Manor scheme.

On a division, 15 voted for the amendment, and 7 for the motion; and the former was accordingly carried.

After the meeting, Bailie Archibald announced his intention of retiring from the convenership of the Works Committee.

LEEDS CORPORATION WATER SUPPLY.

The Leakage at the Eccup Reservoir.

A very interesting stage (says the *Leeds Mercury*) has been reached in the work now being carried on at this reservoir. It will be recollected that some time ago serious leakage took place; the amount of water running to waste being calculated at about 2 million gallons per day. When measures were at first taken for dealing with this state of things, holes were bored in the hope that cement might be poured in such quantity into these receptacles that the waste of water might be obviated, or, at least, very materially lessened. This step did not meet with the success that was hoped, and the plan of excavating, with the object of ascertaining the condition of the puddle wall, was then agreed upon. This excavation has now proceeded so far as to discover pretty accurately the state of things the Water-Works Committee have to deal with. Large quantities of cement were used for the purpose above stated; no less than 33 tons being placed in some of the bore-holes. Strange enough, as it seemed at the time, the whole of this material disappeared; and it is now seen that it found a lodgment at or about the level to which the excavations have now reached. On Friday, the 19th inst., ridges of this cement—in one case no less than 90 feet in length—were brought to view; and it was seen that several of them ran right across the wall of puddle. These accumulations of cement are situated in what must have been fissures in the wall; and it is evident that the discoloration of the water which at one time escaped from the reservoir must have been due to the washing away of the puddle during its passage through these crevices. While a tolerable idea exists upon the manner in which the fissures were originally formed, it will remain for the next two or three months to declare with closer accuracy how the existence of the crevices came about, and why the puddle in the trench did not sink uniformly, so as to preclude the possibility of such fissures being made. It is believed that the work now in progress will shortly reveal the real nature of the defect for which search has been made. Altogether, apart from the quantity of water lost by leakage, it is clear that the wearing away of the clay structure could not have been allowed to continue, and the Water Committee and the Engineer (Mr. T. Hewson) may be congratulated upon the self-evident results of their operations.

THE CONGRESS OF HYGIENE AND DEMOGRAPHY.

Papers Relating to the Treatment and Disposal of Sewage.

In previous issues of the JOURNAL, we have noticed the papers on water supply read at the above Congress, which was recently held in London. We have now to deal with some of those relating to the treatment and disposal of sewage.

The first paper calling for attention was one by Professor H. Robinson, on "Sewage Disposal in Relation to Water Supply and River Pollution." The author pointed out that sewers designed to carry off storm water and sewerage are undesirable, as being too big for the work in dry weather, and that relief sewers should be more relied upon for use in times of heavy rainfall. The discharge of sewage or manufacturing refuse into streams to avoid the expense of previously treating it must, he said, be protested against; and the rivers must no longer be regarded as the natural vehicle for removing it. What was at first an evil of comparatively small extent has, with the rapid sewering of towns, become one of great magnitude. Public opinion is favourable to the adoption of drastic measures. He thought the Rivers Pollution Prevention Act of 1876 required amendment, so that it should be mandatory instead of permissive. The author advocated the adoption of standards of purity of rivers, and referred to the procedure of the Massachusetts State Board of Health in this respect. The action of organic life in purifying rivers was also referred to. The question of the disposal of sewage by deposition was next attacked by the author. He stated that where land is obtainable in sufficient areas, and of a porous nature, the fertilizing properties of sewage can best be utilized upon it, whether from an agricultural or a sanitary standpoint. This was seldom possible; and where attempts had been made to purify sewage on unsuitable soils, commercial and sanitary failure had resulted. Experience had proved that where clayey or impervious lands had been deep-drained, so as to ensure the passage of sewage through it, the result had been that the sewage had passed into the sub-soil drains only partially unclarified; and in a recent case the deep drains had to be done away with, and the land used for broad irrigation. Twenty years ago the application of sewage to land was advocated under all circumstances; but experience has shown that the result of applying more than a very limited amount of sewage to non-porous soils is that it is not purified, and that sanitary mischief arises. The sewage may be to some extent mechanically strained; but the absence of the necessary free oxygen in the pervious soil prevents purification. When sewage irrigation or filtration is carried on without care and without the knowledge of the chemical and biological laws which require to be considered, there is a risk of pollution to subsoil waters and streams into which the sewage effluent passes. If an area of porous land can be obtained sufficiently large to enable the sewage of about 100 persons to the acre to be applied intermittently, then good agricultural results will ensue. Where sandy soils exist, as the Craigentinny meadows near Edinburgh, or at Gennevilliers, where part of the sewage of Paris is treated, then large volumes can be applied with advantage to vegetation, and enormous crops can be produced. These cases were adduced as conclusive proof that sewage ought to be applied to land. Hungry soils of the nature referred to will, no doubt, pass immense volumes through them, and the crops will retain and assimilate that which they require, to the great advantage of the agriculturist. If, however, the subsoil waters are examined, insanitary conditions will be disclosed, which should point to the necessity of taking a broader view of the subject than has too often been the case when irrigation enthusiasts have had their own way. The author referred to Mr. R. Warrington's experiments at Rothampstead. He remarked that it is an established fact that micro-organisms perform an important function in sewage filtration, and that the action of an earth filter is not mechanical, but partly chemical and partly biological. The destruction of the organic impurities in sewage was shown to be brought about by a progress of active fermentation or decomposition (termed nitrification) caused by bacteria. A question of great practical importance in connection with both sewage disposal and water supply is whether any of these organisms can escape destruction. The conclusion arrived at by the American investigators in the before-mentioned report of the Massachusetts State Board of Health, is that the belief that bacteria cannot survive to pass through sand filters is fallacious, although the great bulk are destroyed. The conclusion arrived at by the author was that, in the disposal of sewage upon land, or in filtering impure water, the necessity arises for exercising great care. Experiments upon sewage filtration have been made by Mr. Hiram Mills, C.E., of the Lawrence Experimental Station in America, which confirm the view that nitrification ceases if the filtration is not conducted intermittently. Also that sewage effluents that have been passed through sand filters covered with soil, in which nitrification took place, resulted in the destruction of bacteria, and that the effluents from such filters were not favourable to the support of bacteria. This is due to the fact that the free and albuminoid ammonias in such effluents, being the residue of a much larger amount that has been destroyed, are much less able to support bacterial life than fresh organic substances containing the same amount of free and albuminoid ammonia. Dr. Sedgwick has also found that some especially hardy bacterial organisms could live to pass through 5 feet of coarse sand filters worked intermittently; and although the large bulk of organisms are destroyed by filtration, some do pass in filters composed of sand alone. When the filters are of fine sand, however, and covered with soil, the bacteria appear to be all nitrified. Chemical preparations for sewage treatment were also touched upon by the author; but he stated that the various systems had not been found to be profitable in working.

The last-mentioned subject was dealt with by Dr. J. C. Thresh, in a paper entitled "An Outline of the various Chemical Processes for Filtering Sewage," of which the following is a summary: The deleterious organic matters contained in sewage may be divided into two classes—those held in solution, and those held in suspension. The latter again may be divided into living organisms and dead organic matter. The various processes which have been devised for the removal of these impurities may be classified as follows: (1) Subsidence, with complete rest, or by passing through large tanks with a very slow but continuous flow. (2) Filtration through screens or filter-beds of gravel, sand, cinders, &c. (3) Percolation through materials exerting some chemical, or catalytic action on the organic matter—such as animal charcoal, metallic iron, polarite, magnetic carbide, or other compounds of iron, manganese, &c. (4) Precipitation by the addition of chemicals capable of combining with certain of the organic constituents, with the formation of insoluble compounds, such as the soluble salts of iron, aluminium, zinc, &c., hydrate of lime. (5) Precipitation, &c., by electrolytic treatment, as in Webster's process. (6) Destruction of the organic matter by oxidizing agents, as by the addition of permanganates and acid. (7) Sterilization, where destruction of all micro-organisms is chiefly aimed at as in the Amines process, or by the addition of chlorinated lime, carbolic acid, and other antiseptics and disinfectants to retard or prevent putrefactive changes. (8) Nitrification, the oxidation of the organic matter by organisms in the surface soil by intermittent percolation of the sewage through specially-prepared land. (9) Utilization of the organic matter as food for growing crops—broad irrigation. Not one of these processes, except perhaps the last, is capable of giving satisfactory results; but the extent to which the puification should be carried depends chiefly upon the way in which the effluent is to be disposed of. Where it can be cast with safety into the sea or into a large tidal river, purification need not be so complete as where it must flow into a stream or river which a few miles farther down furnishes the water supply to other towns or villages. In the latter case, it is absolutely necessary that the sewage should be so treated as to deprive it of all specific organisms, and of the largest possible proportion of both suspended and dissolved organic matters. To effect this, a combination of two or more of the above-named processes must be resorted to. The combination to be adopted varies according to circumstances, depending chiefly upon the character of the sewage, the position of the town, and the mode in which the effluent is finally to be disposed of.

Dr. A. Carpenter read a paper "On the Duty of a Locality to Utilize the Nitrogenous Matter in its Sewage for the Benefit of the Nation," wherein he remarked that the object of the paper was to show that localities had duties to the nation to which they belong. The cost of utilizing sewage might exceed the financial returns from the cultivated lands, and for that excess the locality utilizing the sewage would have to pay; but the author contended that the increased production of crops tended to decreased price, which was a national advantage. He expressed the belief that density of population need not involve protective measures to exclude contamination from our streams; but, on the contrary, bacteriological research clearly indicates, on the one hand, the value and importance of purifying, by the very best available means, all dangerous liquids, such as sewage, before admission into rivers, and, on the other hand, to submit the water drawn from streams for town supply to the most careful subsidence and filtration through sand before delivery.

Mr. R. E. Middleton, M. Inst. C.E., read a paper on "The Removal of Sewage after Leaving Buildings." It was as follows:—

The writer proposes, in the following remarks, to give a short

description of different systems for the removal of sewage matter from houses and streets to the sea, to land, or otherwise. He desires to set forth, as simply as possible, the difficulties attendant on each system which has been adopted in the endeavour to find an efficient, economical, and rational means of removing sewage from its point of origin to that of disposal.

The system of sewerage which has been most generally adopted in this country, and which has existed from the earliest times, is that of large sewers calculated to admit of the passage of all the sewage matter and storm water which the district receives. So long as it was possible to turn the sewage thus collected into the nearest river or stream, or into the sea direct, this system of large sewers was the natural sequence of such disposal; but the injurious consequences of this course having become apparent, in the dangerous pollution of rivers and streams, and the offensive condition of the seashore in many places, whereby the country was to a considerable extent deprived of its most natural and least artificial source of water supply, it became necessary to enact that sewage matter shall not be turned into rivers unless it has been previously rendered innocuous. This enactment has obliged engineers to consider the most economical and efficient means of transporting sewage to much greater distances than was formerly thought necessary; and as storm water forms a very large proportion of the mass of sewage to be carried, one of the first questions to arise was as to whether the sewage matter might not be separated from the water, and each disposed of in a different manner.

The systems to which attention is called, and which have been tried with the object of meeting these requirements, are the earth system, the pail system, the system of sealed cesspits, and the separate system. The first-named system fails since it is impossible to ensure its proper use, because urine and slop water are frequently mixed with the dry earth, which then ceases to be a disinfectant, and because it does not deal with the kitchen and bath water, with soap and fat, which must be turned into cesspits to ferment, or into watercourses to pollute them. The pail system is an outcome of the earth system, and need not be more particularly referred to. In the sealed cesspit system, the sewage matter is discharged into what purports to be a hermetically sealed cesspit, and is removed by pumping into specially constructed sewage tumbrils, and is carted away and deposited on land. It is clear that when any discharge is made into the cesspit, the gases of fermentation come out by the same passage. The removal into the tumbrils is also offensive; and the system is not believed to be a successful one, though it has been largely used abroad.

The most important of the proposals which have been made is that of separating the sewage proper—that is to say, the fæces, the urine, fat, soap, kitchen water, and the water of transportation—from the storm water; returning the latter to the nearest watercourse, and only transporting the former to a distance, where it may be treated on land, chemically, by precipitation, by electricity, or by two or more of these systems combined, the effluent being returned to the watercourse.

Under the conditions which exist in this country, the proportion which the sewage matter at its maximum bears to the storm water at its maximum is probably about 1 to 25. In tropical countries this proportion is greatly exceeded; while the duration of the rainfall is much concentrated, and the length of the time during which there is no rain is correspondingly increased. Assuming the above figures to be correct, sewers to carry storm water must be 25 times larger than where sewage only is to be transported. These dimensions must be much increased when the rainfall is tropical; and these same sewers will in time of drought be almost empty, the rate of delivery in them will be very slow, and they will become foul to an excess, and must be dangerous to health, especially under tropical conditions of great heat, and long periods of continued drought.

When brought face to face with these facts, it seems to be almost obvious that the sewage proper should be dealt with alone, and that the storm water should be separated from it, more particularly as the heavier portion of the matter to be transported, and that which is most apt to produce deposits and obstructions, is introduced into the sewers with the storm water. The question, however, is not quite so clear as it seems to be at first glance.

The advantages which the separate system offers appears to be: (1) The use of very small sewers. (2) A fair amount of regularity in the amount of sewage passing through the sewers, which will not vary greatly either in quantity or quality, and which will, at certain times in every day, carry a known maximum and minimum of sewage. (3) The gradients can be arranged to give a minimum rate of flow which shall not allow of deposit. (4) Where pumping has to be employed, the volume to be pumped is reduced to a regular diurnal unit, as against a quantity which may vary in the proportion of from 1 to 25 or more, according to the rainfall, and which necessitates the use of pumping machinery, tanks, and other appliances calculated to deal with the larger quantity. (5) The comparatively small alteration of level of the sewage matter in the sewers, and the fact that the variation in the rate of flow would be reduced and the average rate made higher, should tend to prevent pressure from the evolution of gases, and should shorten the time of delivery, and, therefore, that in which fermentation can take place, and so should tend to health. (6) The heavier matter, such as the road scrapings, coal dust, &c., is not passed into the sewers, but into the watercourses; and the former should, therefore, be maintained free from deposit with great facility. (7) From the small size of the sewers and the comparatively regular flow of sewage in them, they offer great facilities for more thorough and regular ventilation than has been hitherto found possible in the larger sewers.

Against these advantages must be placed the increased complication of the drainage system—not as a whole, but in the streets; and the fact that, as the gradients of drains of small size must be steeper than those which carry a larger volume, the height through which the sewage has to be pumped, where pumping becomes necessary, will be greater than for large sewers though the quantity to be dealt with is much less. The proportion can, however, be only decided for each particular case.

The separate system appears to offer many advantages for the collection of sewage, in very flat districts, in receivers, of limited capacity, placed at comparatively short distances apart, whence it may be discharged or pumped to a higher level by steam power, or by water or air pressure supplied from a central station. It is thought that the use of air is most advantageous for this purpose, as very much smaller pipes can be used for its transmission than is possible when water is employed as the motive power—a speed of 60 feet per second being quite admissible when air is used, while 3 feet per second would be about the limit for water; and there is no shock with the first-mentioned form of power, while there is considerable shock with the second. The efficiency obtained with the use of compressed air is considerable, and might, it is thought, be greatly increased by its more careful and scientific employment, both as regards the construction of receivers, the height of the lift, in the compressing machinery, by the reduction of waste space, and in heating, and by the expansive use of the air. Where water is employed as the motive power, space must be provided in the sewers or watercourses for the exhaust water; while the air may be discharged into the sewer without taking up useful space, and may serve to ventilate it. On the other hand, this air, which has been in intimate contact with sewage matter (presumably, however, little fermented), may be discharged into the streets through some opening, and may become a source of danger.

The writer wishes to call particular attention to the necessity which exists for considering each locality on its own merits and conditions, and for providing a system of sewerage which is applicable to those conditions. The same sewers which may do very well in a hilly country are not adapted to one that is flat. A system which is successful in a temperate climate, where the rainfall is moderate and much diffused, is not necessarily adapted to a tropical country, where the heat is great; and the rainfall is excessive and concentrated. The separate system is, no doubt, not universally applicable; but the writer believes it to have many advantages which only require consideration to be recognized.

Brisbane Gas Company.—The Directors of this Company report only a very slight increase in the quantity of gas sold during the half year ending June 30 last, as compared with the corresponding period of 1890. This, they say, is to be attributed to depression in business. The amount standing to the credit of the profit and loss account at the above-named date was £11,844, out of which the Directors recommend a dividend of 6 per cent. The payment of this and the dividend tax would leave a balance of £3030 to be carried forward.

The Dangers of Paraffin Lamps.—We are indebted to a correspondent in the neighbourhood for the following cutting from the editorial columns of the *Ilkeston Advertiser* of the 19th inst.: "The danger, hidden but ever present, attending the use of the ordinary domestic paraffin lamp has once more received a fatal illustration at Ilkeston. One of these innocent-looking lamps was standing last Tuesday night on a table in the house of John Thomas Matthews at Ilkeston Junction. The good wife was preparing supper ready for her husband when he came home weary with his toil. At the table on which the lamp was placed sat a little boy under two years of age, eating the bread and milk which formed his nightly meal before retiring to bed. Another child, a girl of eight, was at another table. Such was the peaceful scene into which the evil genius of the lamp brought destruction and death 'at one fell swoop.' Without a moment's warning, the lamp burst, the boy was ablaze with the flaming oil, and the mother set herself on fire by her efforts to save her literally frizzling infant. The poor woman held the child as long as nature could bear the flames, and then she had to put it down in the yard for neighbours to quench the fire which played over its quivering flesh. Both were shockingly burned. The child died in a few hours; but the mother, it is hoped, will recover under the care of the excellent matron of the cottage hospital, and the medical staff there. The reason for the disaster baffles pursuit. The lesson is that wherever gas is available, paraffin should be abandoned." In calling attention to the foregoing, our correspondent remarks that it is very seldom that sellers of gas get the true moral of the large number of paraffin lamp accidents that occur publicly acknowledged.

The Norton Water-Tower of the Liverpool Water-Works.—Last Saturday week, the members of the Liverpool Engineering Society paid a visit to the Norton water-tower in connection with the Vyrnwy works of the Liverpool Corporation. The party, after a pleasant drive, arrived at Fiddler's Ferry, where they were met by Mr. A. W. Brightmore, C.E., the Liverpool Corporation's Resident Engineer in charge of the Norton and Fiddler's Ferry section of the Vyrnwy water scheme. Under this gentleman's guidance, the company were enabled to make a thorough inspection of the work at the ferry. The pipe-line is taken under the Manchester Ship Canal, a section of which is at present in course of construction, and runs parallel with the River Mersey at Fiddler's Ferry. The pipes are conveyed down a shaft to a depth of 20 feet below the bed of the canal. On the other side of the canal, they are brought up and carried a short distance, and taken down a shaft 50 feet deep, and then under the Mersey. Up to the point of reaching the canal, the pipes are 42 inches in diameter; and under the canal they are reduced to 36 inches. The temporary pipes which at present convey the water as far as the canal are 24 inches in diameter, and under the canal 21 inches. The water is taken under the ferry in a 12-inch flexible tube, which is in 50 sections, each section containing five valves. The tunnel through which the pipes will be taken under the canal is completed; and the permanent pipes are in, but are not yet jointed. The journey was afterwards resumed, and a drive through a lovely country brought the party to the chief object of the excursion—the water-tower. The tower is a large circular-shaped building 80 feet in diameter, constructed of huge blocks of red sandstone, and is in the Tuscan style of architecture. It is 100 feet in height; the total height with the tank being 115 feet. The tank is the same number of feet in diameter as the tower; and it is capable of containing 50,000 gallons of water. Running the whole circle of the coping stone is the following inscription in Latin: "This water, derived from the fountains of the Severn, is laid eighty miles through the hills and valleys of Wales and intermediate country to the city of Liverpool, at the expense of the Municipality, in the year of our Saviour 1890." After the inspection, the visitors dined together at Frodsham.

NOTES FROM SCOTLAND.

From our Edinburgh Correspondent.

EDINBURGH, *Saturday.*

The Aberdeen Town Council had before them on Monday a motion by Mr. Pratt which proposed that the Council should request Mr. A. Smith, the Gas Manager, to withdraw and apologize for threatening language used by him towards Mr. Pratt in the gas-works on the 13th. of August. Lord Provost Stewart ruled that the motion was incompetent, seeing that it dealt with a private matter. There could be no legitimate end, his Lordship said, to the motion, if adopted, but the discharge of Mr. Smith. They had been treated at several meetings, he went on to say, with nothing else but "Mr. Pratt and Mr. Smith;" and they did not want it any longer. Some members of the Council wished an inquiry; but the Lord Provost stoutly declined to make a public matter of Mr. Pratt's complaint. He proposed, however, along with two other members, to meet Mr. Smith and Mr. Pratt in private; and the latter gentleman having agreed to the proposal, his motion was allowed to drop, which, it is to be hoped, is the last that will be heard of an unpleasant incident.

The Edinburgh and District Water Trustees last Thursday disposed of two important items of business. The first was the fixing of the assessments for the current year, regarding which there has always been unanimity, but upon which this year there was a hot controversy. By a majority, the Finance Committee recommended that the assessments should be fixed at 6d. per £1 on occupiers of dwelling-houses; 2d. per £1 on occupiers of shops, &c.: 1d. per £1 for the public water-rate; and a trade rate of 6d. per 1000 gallons—all the same as last year. The minority proposed the important alteration of fixing the domestic rate at 5½d. per £1; and they were led by Mr. Colston, who is Convener of the Committee. Bailie Archibald headed the majority, and moved the adoption of their recommendation; dwelling upon the fact that the domestic rate was already as low as it is anywhere in the kingdom, and arguing that, if a reduction were to be granted, it ought to be to the trading community. He also urged very strongly that the reduction would benefit most the wealthier classes; and that, as a matter of fact, out of 65,000 householders in the district, 30,000, and those the poorer classes, would receive no benefit at all. Mr. Colston urged the view that the Trustees were bound to lay on an assessment which would meet the outlay of the year, and that they had no right to levy £3000 more than was necessary, as was proposed to be done. A warm discussion followed, in which Mr. Colston was informed that he had in previous years consented to the imposition of heavier assessments than were necessary, as was evidenced by the circumstance that the Trust at present possess about £13,000 surplus. In the division which was taken, 14 members voted for the 5½d. rate, and 9 for the 6d. rate; and the former was consequently adopted. The controversy really had reference to the question of the proposed additional water supply; the object of Bailie Archibald and his followers being to accumulate surpluses year by year, and so to lighten the charges connected with the new works. Technically, Mr. Colston was right. The Trust have no power to amass funds any more than to accumulate arrears. But the extra ½d. per £1 would not have been either missed or grudged by the community; and its absence will make the burden of introducing the additional supply, when it is brought in, heavier to bear. In that sense, Bailie Archibald, seeing he had precedent on his side, would appear to have made the most sensible proposal.

The second question was the more important one of whether the Trust should go forward in the next session of Parliament with their scheme for the introduction of the additional water supply from the Manor Water, as recommended by Messrs. Hill, Gale, and Mansergh, the Engineers who were consulted by the Trust. This subject also resolved itself into a fight between Bailie Archibald and Mr. Colston.* The former moved that they proceed with the scheme; and the latter, that they wait till after the municipal elections in November. This was practically putting aside the question for another year. Mr. Colston was again successful; and the matter is accordingly shelved. It will be made an election cry in November; and upon the view which the community may take will depend the action of the Trust next year. Very little divides the two parties. In fact, Mr. Colston stated his belief that an additional supply of water will be required before very long, and that the Manor Water is unquestionably the best to be had. The real explanation, I presume, of the defeat of Bailie Archibald lies in the fact that this year the election of a Lord Provost for the city of Edinburgh has to be made; and as the Town Council are likely to be sharply divided over the business, councillors are averse to taking up any position which might cause them to lose their seat, and thereby jeopardize their nominee for the provostship. Next year, when there will be no disturbing element such as there is now, the water question will be taken up and decided. The public need not flatter themselves with the belief that anything they may say will have the least effect on the decision. The Water Trustees have the duty laid upon them of providing a sufficient supply of water for the people; and, having been advised by experts of high authority that more water is required, they cannot shirk their responsibility in the matter. It is advisable that the public should be fully informed of what is proposed; but to consult them as to what the Trust is to do, is reducing the members of that body to nonentities. The manly and the honest course would have been to have adopted a scheme, and resolved to stand or fall by it, and not to have asked the public to formulate a scheme for them.

The east of Scotland was visited last Monday by a rainstorm of unusual severity—as much as 3¼ inches being reported to have fallen at one place in Berwickshire in 24 hours, and 5½ inches at a spot in the Pentland Hills, where the counties of Mid-Lothian and Peebles meet, in 29 hours. At Peebles, where the gas-works occupy a site at the junction of the Eddleston Water with the Tweed, the water rose till the retort fires were extinguished; and but for the fact that a holder in another part of the town was full, the place would have been without gas. As it was, damage to the amount of £50 was done. At Innerleithen, a few miles farther down the Tweed, another tributary came down in such flood that the gas and water pipes were carried away at one place, and the town was left in darkness for the night. In the Aberdeen district, the rain was not quite so heavy; but it reached the high figure of 2·2 inches in 24 hours. Late on Monday night, an alarming telegram reached the city, conveying the information that the water-main at Invercannie, a short distance below the reservoir, had been damaged by the flood. Several of the city officials and a number of workmen at once started for the spot by special train, and spent the night examining the place by means of lanterns. Fortunately, their inspection revealed nothing worse than a subsidence in the roadway, which had not in the least injured the pipe. Aberdeen is dependent upon one main; and had it been fractured, the city would have been without water in the course of three days at the most, if the damage had not been repaired in that time.

As I thought, the Gas Committee of the Aberdeen Town Council have declined to be led into the specious scheme for electric lighting by water power which was presented to them by Mr. Evelyn Liardet, of London. At their last meeting, they instructed their Clerk to write to Mr. Liardet "thanking him for the trouble he had taken, and for the admirable report he had prepared, but intimating that the Committee did not see their way in the meantime to make any recommendation to the Council upon it." Mr. F. Noll, also of London, had been consulted by the Committee as to the water power which might be derived from the River Don; and his report was that 150-horse power could be obtained, "but that if the whole of the water of the Don could be brought through the sluice, something like 550-horse power might be secured." Mr. Liardet claimed that by his scheme 600-horse power would be obtained. In his scheme he employs the water to drive turbine-wheels four times in succession; and I understand that the Gas Committee's difficulty in the matter was to see how sufficient fall could be obtained for wheels placed in series.

The latest and most extraordinary electric lighting craze I have encountered is at Dufftown—a village of 1300 inhabitants, situated in the Highlands of Banffshire. There the gas-works are beside a distillery, the proprietor of which is desirous of acquiring their site, for building purposes. The capital of the Gas Company is £498, in £1 shares, and the works cost £800. The owner of the distillery offered to purchase them for £500. A meeting of the inhabitants was held last week, to consider what their attitude in the matter should be. A Mr. Spence, a local clothier, who presided, urged the people to adopt electricity as their lighting agent; assuring them that "there would be a saving as compared with gas," and that "gas in 10 or 15 years would be a thing of the past." A Committee was appointed to consider the subject, with power to take the opinion of an electric lighting engineer as to the probable cost. The Provost of the place—a Mr. Syme—asserted that, notwithstanding croakers, electric lighting would go on; and supposing he mortgaged the last stone he owned, he would go in for it." What could be done after such a statement from the head man of the place? The Directors of the Gas Company met on Wednesday, and resolved to accept the offer of £500 for their works. At the public meeting of the inhabitants, a letter from a Wolverhampton firm was read, which stated that the cost of an electric lighting installation for such a place as Dufftown would be £1500; and all I can say of their resolution to go on, after learning this, is that the inhabitants must be infatuated.

*A report of the discussion appears elsewhere.—ED. J. G. L.

From our Glasgow Correspondent.

GLASGOW, *Saturday.*

The Dumbarton Corporation gas accounts for the year ending Aug. 1, 1891, have just been completed. In the revenue account, it is shown that the gas-rental amounted to £6143, and that the sales amounted to £1599. These, with sundry other items of income, bring up the total receipts to £7839. On the expenditure side, the outlay for coals is set down at £3341; and for lime there was expended a sum of £168. Salaries and wages account is given at £1084; wear and tear, at £555; fittings account, at £138; rates and taxes, at £374; interest, at £435; annuities, at £384; and sinking fund, at £266. The gross expenditure was £6878; thus giving a balance amounting to £961 to be carried to the profit and loss account. The capital account shows, as debts, the annuitants' holdings amounting to £13,500; loans on debenture, £10,350; balance of consumers' deposit account, £1339; a sum of £11,455 as balance in the shape of accumulated profits; and a profit balance of £28 on property. These various items amount to £36,673 The assets side of the capital account shows that up to the 1st of August, 1890, there had been expended on the gas undertaking a total sum of £32,286; while during the past year the extensions completed ran up to £446. The house property (in Castle Street) appears as an asset valued at £1621; and with cash in bank and in Manager's hands, the total assets stand at £36,673. A sum of £3113 appears as the sinking fund account, which is the amount spent in purchasing the gas annuities.

Several cases of appeal against the valuation assessments of gas-works within my province have lately been settled. The Dunoon Gas Company appealed against the valuation of their works being fixed at £800. Mr. Maxbone (the Assessor) stated to the Appeal Court, when the case came up for consideration, that he had seen several of the Directors of the Company in Glasgow, with the result that the valuation had been adjusted; the amount of it being fixed at £737. The valuation of the Denny Corporation Gas-Works was returned by the Assessor at £340; but from that amount an abatement of £140 has been made. There was an appeal from the Stirling Gas Company, which came before the Burgh Valuation Appeal Court last Monday evening; the Court consisting of the Provost, Magistrates, and Town Council. On behalf of the Gas Company, Mr. Chrystal objected to the valuation of £2000, and held that it should be reduced to £1600. The Assessor was represented by Mr. Buchanan, who submitted a statement of the valuation worked out on the basis of the Kinross case. The valuation on that basis was £2019 18s. 5d. In bringing out this sum, there was allowed £150 for property beyond the burgh; 4½ per cent. on £4000 of tenant's floating capital, 20 per cent. as tenant's profits, and £10 for tenant's insurance; and the Assessor's agent asked that Mr. Chrystal should state why the Company wished the valuation reduced to £1600. A long discussion then took place between the two law agents, in the course of which the questions mostly dwelt on were the meter capital, put down at £7500, and the meter-rent. At the close of the discussion, Provost Yellowlees said

there was no apparent difference between the agents except as to the question of meters and insurance. With regard to the question of meters, he was inclined to make an allowance for them, as they were not heritable subjects, but moveables, and things a tenant would require to have to carry on his business. As to the value of the meters, the sum of £7500 put upon them by the Gas Company was a large one; but he was prepared to accept it. He thought, however, 4½ per cent. was quite sufficient to allow as interest on that sum. He further allowed a sum of £30 as tenant's insurance, and £70 for outlays on repairs; giving a net result of £1852 8s. 5d. Mr. Chrystal intimated an appeal, as also did the Assessor.

The relations of the Trade Council of Falkirk with the local Gas Company came up before the first-named body at their ordinary meeting held on Thursday evening. In moving the approval of the Lighting Committee's minutes, Mr. Flannigan said that it would be injudicious in the meantime to make any lengthy statement with regard to the question of gas, seeingthat they were in conference with the Directors of the Gas Company. They ought to wait until they had the opinion of the Directors as to what concessions they were prepared to offer them for the large sum of money which they received from the town for lighting the lamps within the burgh. Bailie Hamilton said he was sorry that the gas had turned out bad again; and he hoped that the Committee would bring pressure to bear on the Directors to make it better. Mr. Flannigan repeated that he wished to avoid the discussion. The question would be fully gone into at the conference with the Directors. Mr. Storay hoped that it would not go forth from the meeting that the Gas Company had the upper hand of the Council. They could not now open the streets of the burgh without sanction. That was an important consideration, and one which was likely to bring the Directors to their senses. Eventually Mr. Flannigan's suggestion was agreed to.

The Glasgow pig iron market has been steady during the past week, and Scotch warrants have remained at about 47s. 6d. per ton, at which there were sellers yesterday afternoon. No great fluctuations in the price of Cleveland and hematite iron have been recorded. There has been a much larger amount of dealing this week, more especially in hematite iron, for which some very large lines have changed hands within the past two or three days.

There has been a quieter week in the Glasgow coal trade; but prices have not eased—the better tone in the iron and steel trades making coalmasters firm in their ideas. Although freights have stiffened a bit, the shipping business continues brisk, and complaints have been rife at the delay in getting supplies forward. The amount shipped last week was 4000 tons more than in the previous week, and 20,000 tons above the corresponding period of last year. It is satisfactory to note that the trade to South America has been expanding, as the Baltic demand will soon be commencing to diminish with the approach of winter. Main coal has been given at 8s. per ton f.o.b. The dearness of gas sorts has influenced splint descriptions, which have commanded 9s. per ton. Steam has been quiet, as also ell coal. Dross continues a drug in the market; the available supplies far exceeding the demand.

CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *Sept.* 26.

Sulphate of Ammonia.—Large dealings are reported in country parcels (both Leith, Hull, and Liverpool delivery) from the London market; but as they seem to be confined to transactions among the operators themselves, the business announced must be taken *cum grano salis*. It is certain that makers have not accepted the low prices quoted, and the parcels which may have changed hands will, therefore, be second-hand ones, and are probably small in quantity. There can be but one object in the present *modus operandi*. The speculators attempt to coerce the producers into selling for future delivery at present low values; and for this purpose, they will endeavour to bring figures for spot lots to the lowest possible level. The latter will not be a matter of great difficulty, while the demand is slack as at present; but it seems doubtful whether any maker will be lured into practically giving away his future production, however misleading the accounts of the market given by the speculators may be. The present anomalous position of sulphate towards nitrate has been pointed out in the JOURNAL; and while the latter cannot be bought below 9s., the prices of sulphate are more likely to advance than recede during the season. Therefore, whatever makers decide to do as regards their present production, it would be most unwise to book forward contracts on the basis of the existing level of values; they cannot certainly fare worse by doing simply a spot business. If the market is measured by the present doings, we are getting dangerously near the lowest point ever touched; and figures *below* £10 10s. are mentioned for Leith delivery already. The position looks so unreal, that it behoves those who are most affected by the low prices to be particularly watchful, and to guard against the pitfalls prepared for them by the speculative clique.

LONDON, *Sept.* 26.

Tar Products.—Benzols and light products continue dull; and no business of any importance has transpired during the week. Considerable shipments of pitch are being made; and this article continues firm, and in good demand. Anthracene is changing hands at prices named below. But this article has no strength; and there appears a distinct tendency to lower prices. Several large tar contracts have been made during the week, at prices ranging from 23s. 6d. to 26s. Prices may be taken as follows: Tar, 25s. Pitch, 33s. to 34s. 6d. Benzol (nominal), 90's, 3s. 11d.; 50's, 2s. 10d. Toluol, 1s. 5d. Solvent naphtha, 1s. 5d. Crude naphtha, 1s. 2d. Creosote, 1⅞d. Carbolic crystals, 6d.; crude, 60's, 1s. 3d. Cresol, 8d. Anthracene (nominal), "A" quality, 1s. 3d.; "B" quality, 11d.

Sulphate of Ammonia.—This article goes from bad to worse; and the hopeful prospects which were noted a few weeks ago seem to be obliterated by the "bear" speculations of dealers. Business is reported at £10 10s. But buyers hang aloof; and the market seems to be utterly disorganized. Gas liquor is quoted at 4s. 6d. to 5s. 6d.

THE LANCASHIRE GAS COAL TRADE.

From Our Own Correspondent.

So far as all the better qualities of round coal are concerned, the demand continues particularly brisk—many colliery proprietors being considerably behindhand with their orders; while it is very exceptional where anything is now going down into stock. In fact, the accumulation of stocks for the ensuing winter requirements may now be regarded as practically at an end; and as stocks which have been put down are considerably below the average with the end of the summer, it is now more than ever probable that a scarcity of supplies for house-fire requirements will be experienced before the close of the ordinary winter's trade. This outlook is necessarily giving an increased firmness to prices; and in the West Lancashire district a more or less general advance of 6d. to 1s. per ton upon present rates is being talked of for the close of the month. This, however, will scarcely represent more than a return to the full rates ruling last winter, as in most cases the West Lancashire colliery-owners have during the summer given way about 6d. to 1s. per ton upon most descriptions of house-fire coal. In the Manchester district, where the leading firms have made no change during the summer upon the rates ruling last winter, it is scarcely likely that any advance, at present at least, will be put in force; but the outlook for the winter would certainly warrant anticipations of higher prices before the close of the year. As regards inland requirements for iron-making, steam, and general manufacturing purposes, the demand continues only moderate, and supplies of the commoner classes of round coal are more than sufficient. The result is that, at many of the collieries, stocks of these are being put down, and prices remain comparatively low, ordinary descriptions of steam and forge coal being obtainable at 7s. 6d. to 8s. per ton at the pit's mouth; but the probable scarcity of house-fire descriptions will necessarily tend to throw an extra demand upon all the commoner qualities of round coal which can be used for house-fire purposes. This will naturally have a hardening effect upon prices; so that manufacturing consumers have certainly not before them the prospect of any lower prices, but rather that they may be compelled to pay higher rates during the ensuing winter. In the shipping trade, business has been steadily increasing in volume, and prices have been gradually improving. Ordinary descriptions of steam coal are now readily fetching 9s. 6d. to 10s., and in some exceptional cases 10s. 3d. per ton has been paid; while second qualities of house coal are firm at 11s. to 11s. 6d., and best qualities about 13s. per ton delivered at the ports on the Mersey. With regard to engine fuel, the market remains in the same unsatisfactory position that has been reported for some time past. With the increased demand for house-fire coals, there has necessarily been a larger quantity of slack thrown upon the market; while the depression in the salt and chemical trades, and also in the cotton industry, has had a serious effect upon the manufacturing requirements for slack. The result is that there are large excessive supplies, especially in the lower qualities of slack; and these are being pushed for sale at extremely low figures not only from Lancashire collieries, but from outside districts. At the pit's mouth, burgy does not average more than 6s. 6d. to 7s.; best slack, 5s. 6d. to 6s.; while common sorts can be bought from Lancashire collieries at as low as 2s. 6d. and 3s. per ton, and Derbyshire slack has been offered here at as low as 1s. 6d. to 2s. per ton at the pit mouth. Coke is in not more than limited demand, with an easier tendency in prices—the best Lancashire cokes averaging 15s. to 16s. per ton at the ovens; whilst Yorkshire cokes are being sold for iron-making purposes at about 11s. 6d. per ton at the ovens.

Northern Coal Trade.—There has been a slight falling off in the demand for steam coal; and best Northumbrian has declined slightly in price—to about 12s. per ton, free on board, with a corresponding decrease in second-class coal. Small steam coal is very weak, at about 4s. per ton, free on board; there being a supply which is very abundant. On the other hand, best Durham gas coal is firmer; the demand (naturally increased at this time of the year) being now very large, both for shipment and for local use. A few of the coal-owners asked 10s. net for this class of coal. But 9s. 6d. is also quoted; and the medium price will be between the two. It is noticeable that the consumption of gas coals continues to grow, in spite of the competition of the electric light. There is a very abundant supply of bunker coal; and the price varies much—from 8s. 6d. for unscreened up to 12s. for best Durham screened, free on board. Manufacturing coal is slightly firmer. But very few contracts have yet been placed for next year's supply; and it would seem that some users anticipate a fall in prices. Coke for blast-furnaces is steadier, in consequence of the better prospects of the iron trade and the larger inquiries. Gas coke does not show as yet any alteration in price; but the output is increasing.

Huddersfield Corporation Gas Department.—It was reported at the recent monthly meeting of the Huddersfield Town Council that the balance-sheet of the gas undertaking for the half year ending June 30 last showed a profit of £2415, which was ordered to be transferred to the borough fund.

The Recent Damage to the Imperial Ottoman Gas-Works.—Mr. W. S. M'Gregor, Engineer of the Imperial Ottoman Gas-Works at Constantinople, has forwarded to us the following translations from the *Stamboul* of the 2nd inst., in confirmation of the account sent by a correspondent, and given in the JOURNAL a fortnight ago, of the recent damage to the works by the severe rainstorm which occurred on the 29th ult.: "In spite of the breakdown of the Dolma-Baghtché Gas-Works last week, there was no want of gas on the evening of the illuminations [the 31st]. This result, which is almost a miracle, considering the worn-out state of the plant, is due in a great measure to the energy of the English officers at Tophaneh, who, with the Engineer of the gas-works, laboured night and day for more than half a week." "The rainfall last Saturday, registered at the Observatory at Haïdar-Pacha (Scutari), was 4·03 English inches. Mr. Lyne, Curator of the cemetery, writes us that no such rainfall has occurred since Sept. 25, 1886."

Mr. Alexander Cameron has commenced business on his own account as a cannel and gas coal merchant at No. 48, West Regent Street, Glasgow.

The New Water-Works at Cardiff.—At a meeting of the General Purposes Committee of the Cardiff Corporation yesterday week, it was resolved to invite the Queen to open the new water-works next year.

Issue of Additional Capital by the Maidstone Gas Company.—At an extraordinary meeting of the Maidstone Gas Company last Thursday week, the Directors were authorized to raise additional capital by the issue of £1000 of new stock in the undertaking.

Increase in Price by the Wandsworth and Putney Gas Company.—The Directors of the Wandsworth and Putney Gas Company have notified to the consumers that, in consequence of the very great advance in the price of coals, and the continued increasing cost of labour, they are reluctantly compelled to raise the price of gas 2d. per 1000 cubic feet. The charge for the Company's gas in future will be 2s. 8d. per 1000 cubic feet; to come into effect from and after the taking of the indices for the present quarter.

Sales of Shares.—At Ilkley yesterday week, a number of £10 shares (ordinary stock) in the *Ilkley Gas Company* were sold by auction, at prices ranging from £17 10s. to £20. The auctioneers (Messrs. Suddards and Stansfield) had for disposal 800 shares, but only 410 were sold—the remainder being withdrawn.——Last Wednesday, 30 original fully-paid £10 shares in the *Pontefract Gas Company* were sold by auction locally for £24 5s. each.——At Malton on the following day, 21 fully-paid £10 shares in the *Malton Gas Company* were sold at from £25 10s. to £26 5s. per share.

The Liverpool Corporation Watch Committee and the Increase in the Price of Gas.—The Watch Committee of the Liverpool City Council, who are, of course, considerably interested in the recent increase in the price of gas, in view of the augmented cost of lighting the city, last Tuesday resolved that an application be made to the Court of Quarter Sessions for the city to appoint an accountant, to examine and report upon the accounts of the Gas Company, pursuant to section 35 of the Gas-Works Clauses Act, 1847, and section 40 of the Liverpool Gas Company's Act, 1848.

Filey Water and Gas Company.—The annual report of this Company shows a small increase in the receipts. The balance of net revenue, after payment of interest on loans, is £710, out of which the Directors recommend the payment of a dividend at the rate of 6 per cent. per annum, which will absorb £600; leaving £110 to be carried forward. The Directors state that, owing to the scarcity of water, they have sunk a borehole on the Company's land at Filey; and at the depth of 375 feet, they tapped an ample spring of pure water, which has been in use since June last, and has given great satisfaction.

The Artesian Well in the City.—At the meeting of the Commissioners of Sewers of the City of London last Tuesday, Mr. Ross (the Assistant Engineer) reported that the artesian well at the Artizans' Dwellings in the Minories had at length reached the contract depth of 352 feet, and yielded from 17,000 to 19,000 gallons of water daily. The dwellings, however, contained 1200 inhabitants; and as it was desirable to provide a minimum supply of 20 gallons per head per day, he suggested that an additional depth of 100 feet in the chalk should be sunk, at an expense of £150. The extra work would take about a month. This was agreed to.

Electric Lighting at Brighton.—The electric lighting installation, which has been put down by the Corporation of Brighton, was started on Monday, the 14th inst. The ceremony was a public one, and took place at the works in North Road, in the presence of the Mayor and Mayoress and a representative gathering of townsmen. The Mayor, in the course of an address, reviewed the history of the Corporation electric lighting scheme; and, speaking of the desirability of local governing bodies having such undertakings in their own hands, instead of allowing them to be "monopolized" by companies, he said they had the Corporation water-works under their control; and they well knew the advantages which they derived from that source. Besides, they were encouraged by the Government to supply gas, water, and electricity; and it became their duty to supply it as efficiently and as cheaply as possible. It was now too late for the Corporation to supply gas; and perhaps this was quite as well for them at present. Mr. Schoolbred explained the process by which electricity is generated and supplied to the town; and the Mayoress then switched on the current.

Inadequate Drainage at Newbury.—The Corporation of Reading having made complaint to the Local Government Board that the Corporation of Newbury had failed to provide their town with sufficient drainage, Mr. S. J. Smith, C.E., one of the Inspectors of the Board, held an inquiry in the Council Chamber, Newbury, last Wednesday. The petition of the Reading Corporation to the Local Government Board having been read, Mr. G. M. Freeman explained that since 1879 there had been constant complaints to the Local Government Board from the Reading Corporation as to the lack of proper drainage arrangements at Newbury, and the great danger to the health of Reading caused by the outflow of the Newbury sewage into the Kennet. The Board had repeatedly sent communications to the Newbury Corporation on the subject, notwithstanding which practically nothing had been done to institute a remedy. In October, 1883, a Local Government Board inquiry with reference to the drainage of Newbury was held in that town, when a scheme, which had then been formulated, was approved, and sanction was given to borrow £25,000 towards the cost of carrying out the works. Up to the present time, however, nothing effectual had been accomplished to remove the evils complained of. Mr. M'Intyre, on behalf of the Newbury Corporation, agreed that there were not sufficient sewers for the drainage of the town. His clients fully admitted that they were in default in this matter, and they were willing to submit to the Inspector's order. The only question was the time which the Board would give them in which to begin and complete the works. After evidence by Mr. Walker, Manager of the Reading Water-Works, and Mr. Anstie, the Engineer, the Inspector decided to allow the Newbury Corporation three months to carry out the preliminary arrangements for efficiently draining the town, and a year and a half to complete the works.

Windsor Gaslight Company.—The half-yearly meeting of thi Company was held last Tuesday. The financial statement presented showed a balance on the capital account of £4578; and at the profit and loss account there was a net profit of £2177. The total expenditure for the half year was £6800; and the income, £8977. The reserve fund stood at £7000. The report was adopted; and the maximum dividend of 10 per cent. was declared, less income-tax.

GAS AND WATER COMPANIES' STOCK AND SHARE LIST.

(For Stock Market Intelligence, see ante, p. 570.)

Issue.	Share	When ex-Dividend.	Dividend or Div. & Bonus.	NAME	Paid per Share	Closing Prices.	Rise or Fall in Wk.	Yield upon investment.
£			p. c.	GAS COMPANIES.				£ s. d.
590,000	10	10 Apl.	10½	Alliance & Dublin 10 p. c.	10	16—17	—½	6 3
100,000	10	,,	7½	Do. 7 p. c.	10	11—12	—½	6 5 0
300,000	100	1 July	5	Australian (Sydney) 5 % Deb.	100	105—107	..	4 13 5
100,000	20	28 May	8	Bahia, Limited	20	13—15	..	10 13 4
200,000	5	13 May	7½	Bombay, Limited	5	6¾—7¼	..	5 3 5
40,000	5	,,	7½	Do. New	4	4¾—5¼	..	5 14 1
380,000	Stck.	13 Aug.	12½	Brentford Consolidated	100	218—223	..	5 9 10
125,000	,,	,,	9½	Do. New	100	157—162	..	5 14 2
220,000	20	16 Sept.	11½	Brighton & Hove Original	20	40—42*	..	5 9 6
320,000	20	10 Apl.	11½	British	20	45—47	..	4 15 9
50,000	10	28 Aug.	11½	Bromley, Ordinary 10 p. c.	10	18—20	..	5 15 0
50,380	10	,,	8½	Do. 7 p. c.	10	13—15	..	5 13 4
328,750	10	13 Nov.	6	Buenos Ayres (New) Limited	10	7—8	..	—
200,000	100	1 July	6	Do. 6 p. c. Deb.	100	90—95	..	6 6 4
150,000	20	13 Aug.	8	Cagliari, Limited	20	24—26	..	6 3 1
550,000	Stck.	10 Apl.	13⅜	Commercial, Old Stock	100	255—265	..	5 3 9
130,000	,,	,,	10⅔	Do. New do.	100	190—200	..	5 7 6
130,000	,,	26 June	4½	Do. 4½ p. c. Deb. do.	100	119—124	..	3 12 7
800,000	Stck.	11 June	10	Continental Union, Limited	100	230—240	..	4 3 4
200,000	,,	,,	7	Do. 7 p. c. Pref.	100	190—200	..	3 10 0
75,000	Stck.	16 Sept.	10	Crystal Palace District	100	197-202*	..	4 19 0
486,090	10	15 July	10	European, Limited	10	20—21	..	4 15 3
354,060	10	,,	10	Do. Partly paid	7½	14¼—15½	..	4 16 9
5,470,640	Stck.	13 Aug.	13	Gaslight & Coke, A, Ordinary	100	228—233	—1	5 11 6
100,000	,,	,,	4	Do. B, 4 p. c. max.	100	94—97	..	4 2 5
665,000	,,	,,	10	Do. C, D, & E, 10 p.c. Pf.	100	254—259	..	3 17 3
30,000	,,	,,	5	Do. F, 5 p. c. Prf.	100	118—123	..	4 1 4
60,000	,,	,,	7½	Do. G, 7½ p. c. do.	100	172—177	..	4 4 9
1,300,000	,,	,,	7	Do. H, 7 p. c. max.	100	159—164	..	4 5 4
463,000	,,	,,	10	Do. I, 10 p. c. Prf.	100	251—256	+1	3 18 1
476,000	,,	,,	—	Do. K, 6 p. c. Prf.	100	153—158	..	3 16 0
1,061,150	,,	11 June	4	Do. 4 p. c. Deb. Stk.	100	112—115	..	3 9 7
294,850	,,	,,	4½	Do. 4½ p. c. do.	100	120—125	..	3 12 4
908,000	,,	,,	6	Do. 6 p. c. do	100	163—168	..	3 11 5
3,800,000	Stck.	13 May.	12	Imperial Continental	100	228—233	—2	5 3 0
75,000	5	26 June	6	Malta & Mediterranean, Ltd.	5	4¼—4¾	..	6 6 4
560,000	100	1 Apl.	5	Met. of Melbourne, 5 p. c. Deb.	100	111—113	..	4 8 6
541,920	20	11 June	6½	Monte Video, Limited	20	16¼—17½	+¼	7 8 6
150,000	5	28 May.	10	Oriental, Limited	5	8¼—8¾	..	5 14 3
60,000	5	25 Mar.	7	Ottoman, Limited	5	4¾—5¼	..	6 7 3
166,870	10	26 Feb.	2	Pará Limited	10	2¾—3¼	..	—
				People's Gas of Chicago—				
420,000	100	4 May	6	1st Mtg. Bds.	100	92—97	..	6 3 9
500,000	100	1 June	16	2nd Do.	100	90—95	..	6 6 4
150,000	10	28 Apl.	10	San Paulo, Limited	10	13½—14½	..	6 18 0
500,000	Stck.	28 Aug.	15½	South Metropolitan, A Stock	100	278—283	..	5 9 6
1,350,000	,,	,,	12	Do. B do.	100	228—233	—2	5 3 0
200,000	,,	,,	13	Do. C do.	100	235—240	—5	5 8 4
700,000	,,	26 June	5	Do. 5 p. c. Deb. Stk.	100	141—145	..	3 9 0
60,000	5	16 Sept.	11½	Tottenham & Edm'nton, Orig.	5	11—13*	..	4 8 5
				WATER COMPANIES.				
729,281	Stck.	26 June	10	Chelsea, Ordinary	100	265—270	+1	3 14 1
1,720,560	Stck.	10 Apl.	8	East London, Ordinary	100	211—216	..	3 14 3
544,440	,,	26 June	4½	Do. 4½ p. c. Deb. Stk.	100	138—143	..	3 3 0
700,000	50	11 June	8	Grand Junction	50	109—114	..	3 10 2
708,000	Stck.	13 Aug	10½	Kent	100	270—280	..	3 15 0
1,043,800	100	26 June	9½	Lambeth, 10 p. c. max.	100	237—242	..	3 18 6
406,200	100	,,	7½	Do. 7½ p. c. max.	100	193—198	..	3 15 9
260,000	Stck.	25 Mar.	4	Do. 4 p. c. Deb. Stk.	100	118—123	..	3 5 0
500,000	100	13 Aug.	12½	New River, New Shares	100	341—346	..	3 10 1
1,000,000	Stck.	30 July	4	Do. 4 p. c. Deb. Stk	100	123—126	..	3 3 6
902,300	Stck.	11 June	6½	S'thwk & V'xhall, 10 p. c. max.	100	165—170	—1	3 16 5
126,500	100	,,	6½	Do. 7½ p. c. do.	100	160—165	..	3 18 9
1,155,066	Stck.	11 June	10	West Middlesex	100	255—260	..	3 16 7

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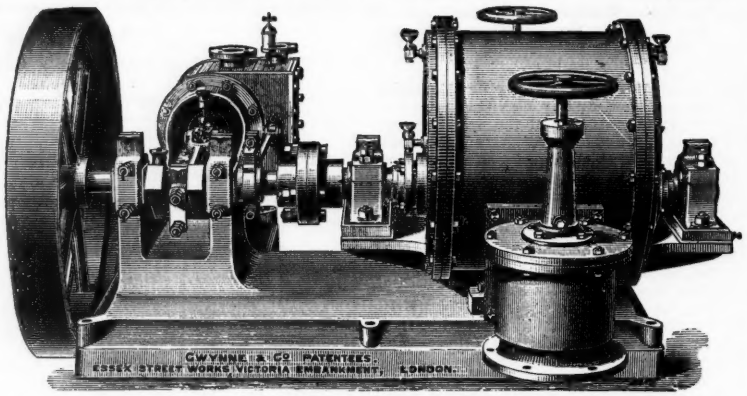

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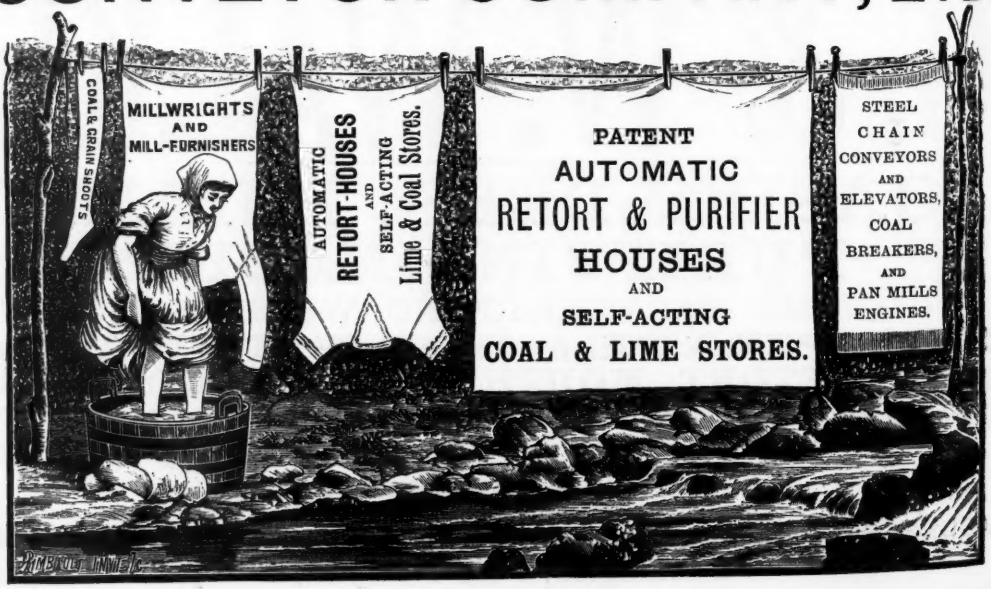
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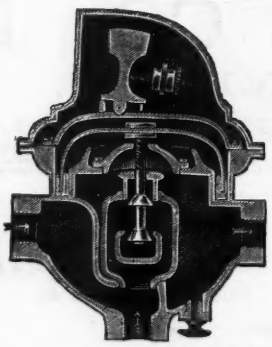

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NEW CUMNOCK, N.B.

Shipping Ports: All the principal Scotch Ports.

HOLMSIDE GAS COALS.
(Wrought out of Holmside and South Moor Collieries.)

PRESENT production nearly 3000 tons per working day. Area of coal about 5000 acres, including the largest remaining workable proportion of pure HUTTON SEAM GAS COAL. Analysis of HOLMSIDE GAS COAL *in bulk as shipped* gives 10,500 cubic feet of Gas per ton, of an Illuminating Power of 16¼ candles. The Sulphur is about 1 per cent., and the Ash 1¾ per cent. The Coal cokes well, and leaves 69 per cent. of excellent Coke. During the year 1890, the London Gas Companies carbonized about 400,000 tons of HOLMSIDE COALS. They are used by The Gaslight and Coke Company, the South Metropolitan Gas Company, the Woolwich (Government) Gas-Works, the Newcastle and Gateshead Gas Company, the European Gas Company, L'Union des Gaz, and by many other Gas Companies both at Home and Abroad.

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UNEQUALLED.
Gas Companies are solicited to try Samples of the
MIRFIELD
BLACK BED GAS COAL.
Prices and Analysis on application.
MIRFIELD (GAS-COAL) COLLIERY COMPY.
MIRFIELD, NORMANTON.

ROBERT MARSHALL,
CANNEL COAL MERCHANT,
97, WELLINGTON STREET, GLASGOW.

Prices and Analysis of all the Scotch Cannels on application.

Awarded HIGHEST MEDAL and DIPLOMA at the Newcastle-on-Tyne Royal Mining and Industrial Exhibition, 1887, for
CANNEL & COAL.

TYNE
BOGHEAD CANNEL.

Yield of Gas per ton	13,155 cub. ft.
Illuminating Power	38·22 candles.
Coke per ton	1,301·88 lbs.

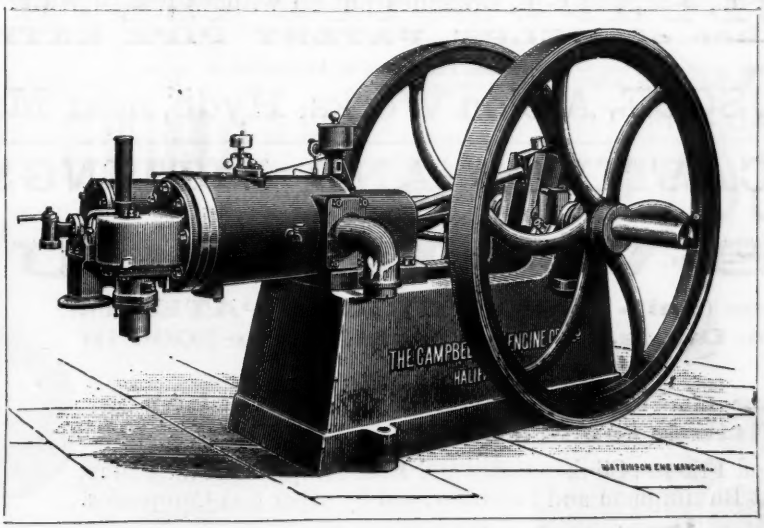
EAST PONTOP GAS COAL.

Yield of Gas per ton	10,500 cub. ft.
Illuminating Power	16·3 candles.
Coke	70 per cent.

For Prices and complete Analysis, apply to
YOUNG, DANCE, & CO.,
Coal Owners, Newcastle-on-Tyne,
Or E. FOSTER & CO., 21, John St., Adelphi, LONDON, W.C.

THE "CAMPBELL" GAS-ENGINE,

MOST SIMPLE AND MOST EASILY MANAGED.



MOST ECONOMICAL IN GAS AND LEAST LIABLE TO BREAKDOWNS.

Our Engines are used by Her Majesty's War Department; The South Metropolitan Gas Company, London, S.E.; at the Sydenham Gas-Works; Tiverton Gas-Works; Filey Gas-Works, &c.

Prices and full particulars from the sole makers—

THE CAMPBELL GAS-ENGINE CO., LTD., HALIFAX, ENGLAND.

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MANUFACTURERS OF FIRE-BRICKS, LUMPS, TILES,

AND EVERY DESCRIPTION OF FIRE-CLAY GOODS.
RETORTS CAREFULLY PACKED FOR SHIPMENT.
A STOCK OF DIFFERENT SHAPES ON HAND.

GAS AND WATER PIPES

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MANUFACTURED BY THE

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GODDARD, MASSEY, & WARNER'S

IMPROVED

Sulphate of Ammonia Apparatus.

The most successful and approved Apparatus known up to the present time.

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RUNCORN SOAP & ALKALI CO., Limited, RUNCORN.
NETHAM CHEMICAL CO., Limited, BRISTOL.
ANIMAL CHARCOAL CO., Limited, SHADWELL.
WM. BUTLER & CO., BRISTOL.
KEMPSON & CO., Pye Bridge.

And to the following Gas Companies and Corporations–

ILKESTON.	BURY.	CHORLEY.
WIDNES.	BRIGHOUSE.	WHITEHAVEN.
HALIFAX.	MARKET HARBRO'.	CHESTER.
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DENTON.	SOWERBY BRIDGE.	LEEK.
ST. ALBANS.	LEICESTER.	IPSWICH.
DUKINFIELD.	DARWEN.	BOURNEMOUTH.
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FOR DRILLING AND TAPPING WATER-MAINS AND GAS-MAINS UNDER PRESSURE.

Patent Saddle Back and Drilling Apparatus, whereby Gas and Water Mains can have 2-in., 3-in., 4-in., 5-in., and 6-in. Branches put on without loss of Water or Gas.

Sole Maker of HELPS' PATENT PIPE EXTRACTOR.

Prices and Particulars on Application to

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Mouthpieces (Self-Sealing, GRICE'S PATENT), Rounds, D's, Ovals, D's to Round. Over 2000 in use.

Mouthpiece Castings, ordinary, in all shapes.
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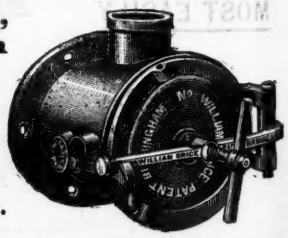

Charging Doors and Frames, Clinker Boxes and Lids complete, Cover Plates and Lids as used at Birmingham and Leicester, and by other Gas Companies.

Purifiers, planed Joints, and Lifting Gear. Ascension, Dip, Arch, and H Pipes. Fire Doors and Frames. Boshes, Deadplates, Bars, Tar-Boxes, Sight-Hole Boxes, Street Caps and Stoppers, Street Valve Boxes, and all Cast-Iron Requisites required in a Gas-Works.

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SPENT LIMES NO LONGER WASTE PRODUCTS.

Under G. R. HISLOP'S PATENTS

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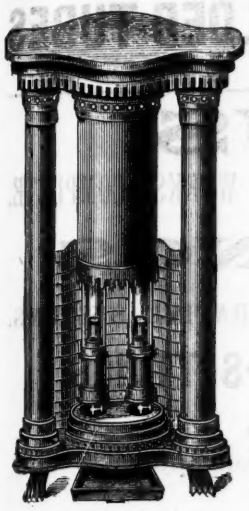
Hislop's Patent Producer and Patent Charging Appliances offer advantages which are unapproachable, while in every other detail his Settings are confidently recommended as being the most inexpensive and effective possible.

Illustrated Pamphlet and Terms on application to J. E. FISHER, Stourbridge, Agent for England and Wales; to C. M. HAMILTON, Portland Place, Hamilton, Agent for Scotland and Ireland; and for all other Countries to the Patentee,

Geo. R. HISLOP, Gas Engineer, PAISLEY, N.B.



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(CLARK'S PATENT.)

Hygienic Gas-Heating Stoves

For Use Without a Flue.

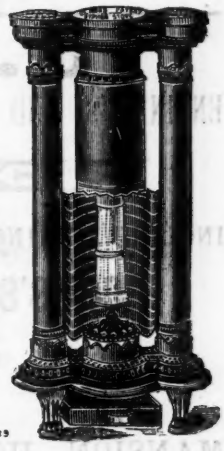
NO FLUE REQUIRED. NO SMOKE. NO SMELL.
NO DIRT OR TROUBLE. NO DANGER.

All sulphurous Vapours are condensed inside the Stoves, and passed off as liquid into the tray beneath.

The "SYPHON" Hygienic Gas-Heating Stoves give a pure, equable, and agreeable heat, which can be graduated and sustained at the will of the user. They are so constructed that a moist or dry atmosphere is obtained at pleasure.

They are the Only Safe Stoves for use in Greenhouses, Conservatories, Bed-rooms, &c., and especially suitable for Halls, Sitting-Rooms, Offices, Shops, Schoolrooms, and Theatres.

Adopted by the principal Gas Companies throughout the Kingdom.



Illustrated Price Lists on application to

S. CLARK & CO., Patentees and Makers,
Syphon Works, Park Street, Islington, London, N.
Telegraphic Address: "Syphon Stoves London."

ORME'S GAS REGULATOR FOR STREET LAMPS

No. 200.
LAMP REGULATOR
Full Size.

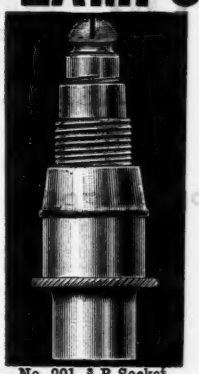
(Behl's Patent)

Adopted by the leading GAS COMPANIES AND CORPORATIONS.

More than 200,000 now in use.

Strongly made, all Brass, as Illustration No. 200.

Price 24/- per dozen.



No. 201, $\frac{3}{8}$ B Socket.
No. 202, $\frac{1}{16}$ B Socket.

ORME'S GAS REGULATOR

(BEHL'S PATENT),

No. 201, 202, 203, FOR DOMESTIC USE.

Saves from 20 to 50 per cent. of Gas.

Gives a bright and steady Light.

Price 15/- per dozen.

SAMPLES UPON APPLICATION.

No. 203, Taper Screw.

STREET LANTERNS OF NEW DESIGNS.

IMPROVED LAMP TORCHES.

ALL BRASS. EXTRA STRONG.

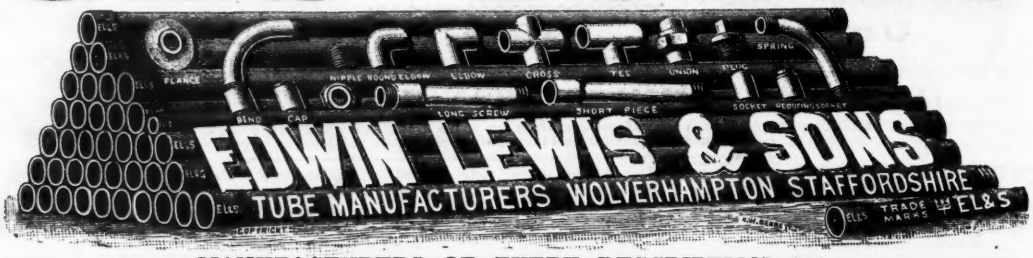
PRICE LIST AND FULL PARTICULARS UPON APPLICATION.

GEORGE ORME & CO., ATLAS METER WORKS, OLDHAM.

Telegraphic Address: "ORME OLDHAM." National Telephone: No. 93.

ESTABLISHED 1825.

GAS TUBES



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FOR ANY PURPOSE.

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SPECIALITIES:

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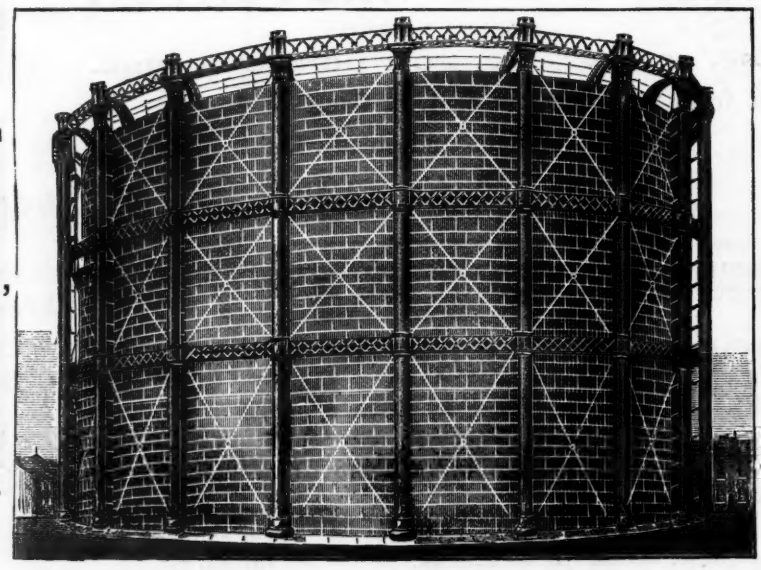

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Have confidence in drawing the special attention of GAS ENGINEERS to the following advantages of their Retorts:—

1. Smooth interior, preventing adhesion of Carbon.
2. They can be made in one piece up to 10 feet long.
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Cast and Wrought Iron Tanks, Purifiers, Condensers, Scrubbers, Retort-Lids, Cross-Bars and Screws, Wrought-Iron Boilers for Stationary, Portable, and Marine Engines, Sugar Pans, Coolers, Clarifiers, Punts, Boats, Bridges, Girders, Roofs, Cisterns, Oil-Tanks, Melting-Pots, Crucibles, Salt-Pans, Arch and Range Boilers, and every description of General Ironwork.

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Specialities in CARBONIZING PLANT.

GENERATOR AND REGENERATOR FURNACES.

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USED AT THE GAS-WORKS

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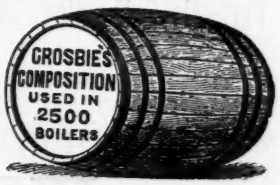
Absolutely Harmless and free from Acids.



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Crosbie's Paints for Gas-Works. Economical and Durable.

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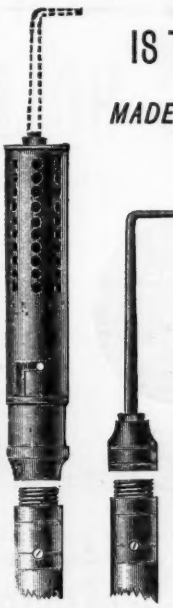

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MADE ENTIRELY OF BRASS AND COPPER.

STRONG AND DURABLE.

Burns well. Does not Blow out or Choke up.

EASILY CLEANED.

COMPLETE WITH ROD AND PUTTING-OUT HOOK.

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ALDWARKE MAIN CAR HOUSE & ROTHERHAM MAIN COLLIERIES, NEAR ROTHERHAM.

ALDWARKE MAIN GAS COAL

Analysis: 12,600 feet of 19-candle gas per ton.

Weight of illuminating power in pounds of sperm, 820·80. Very free from impurities.

Telegrams: "ATLAS SHEFFIELD."

FIRE BRICKS, LUMPS, TILES, BLOCKS, &c.

Special Bricks for Intense Heats.

GAS RETORTS.

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☛ Retort Setters sent to any part of the Kingdom.

SAVILLE'S PATENT REGULATOR WASHER.

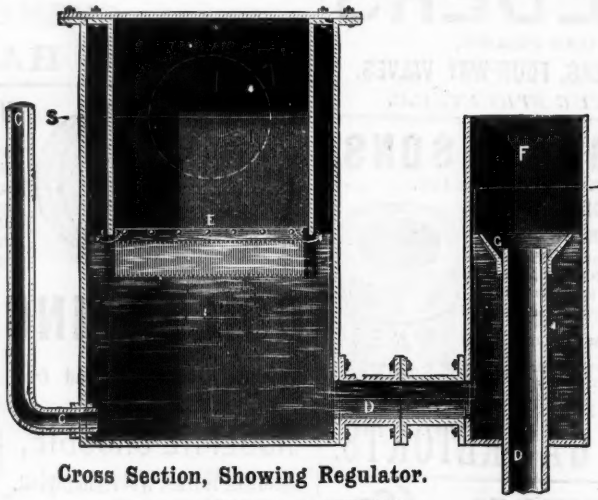
(As described in the JOURNAL OF GAS LIGHTING for Sept. 2, 1890.)

The only Washer without moving parts that can be fixed before an Exhauster.

No more Gas spoilt by over-running the Exhauster.

Perfectly Self-acting.

Particulars and prices on application.



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The only safe arrangement to work without Dip.

Less wear and tear on the Exhauster.

No moving parts.

Occupies small space.

State maximum make of Gas per diem.

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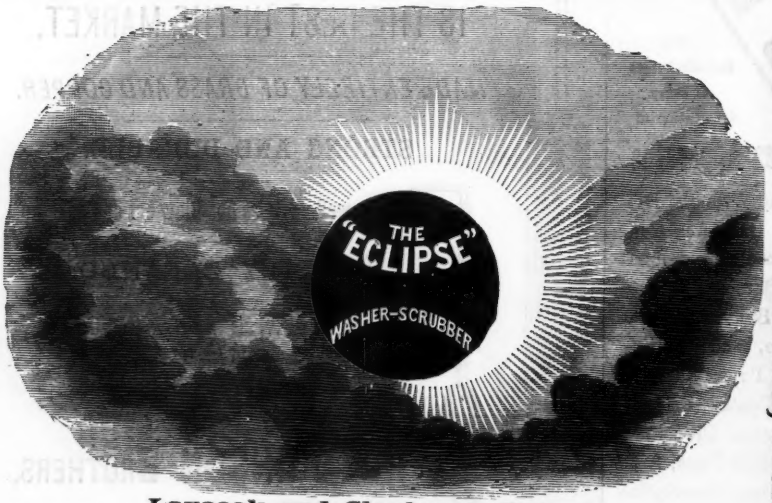

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The most efficient Machine known for extracting Ammonia and other Impurities from Coal Gas.

MACHINES with a total capacity of **42,500,000** cubic feet now working, and give great satisfaction.

LAST YEAR 11 Machines erected with a total capacity of **20,000,000** *feet.*

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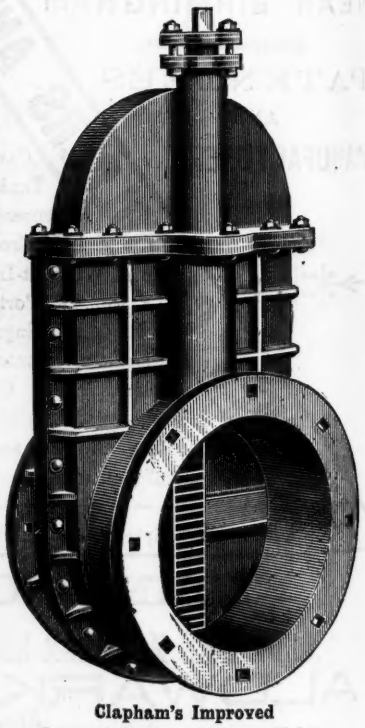
SILVER MEDAL, Inventions Exhibition, 1885.



Clapham's Improved Internal Rack and Worm Valve, Gas-Mains, &c.

London: Printed by WALTER KING (at the office of King, Sell, and Railton, Ltd., 12, Gough Square); and published by him at No. 11, Bolt Court, Fleet Street, in the City of London.—Tuesday, Sept. 29, 1891.